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USER'S GUIDE: COMPUTER PROGRAM WITH INTERACTIVE GRAPHICS FOR AN--ETC(U)
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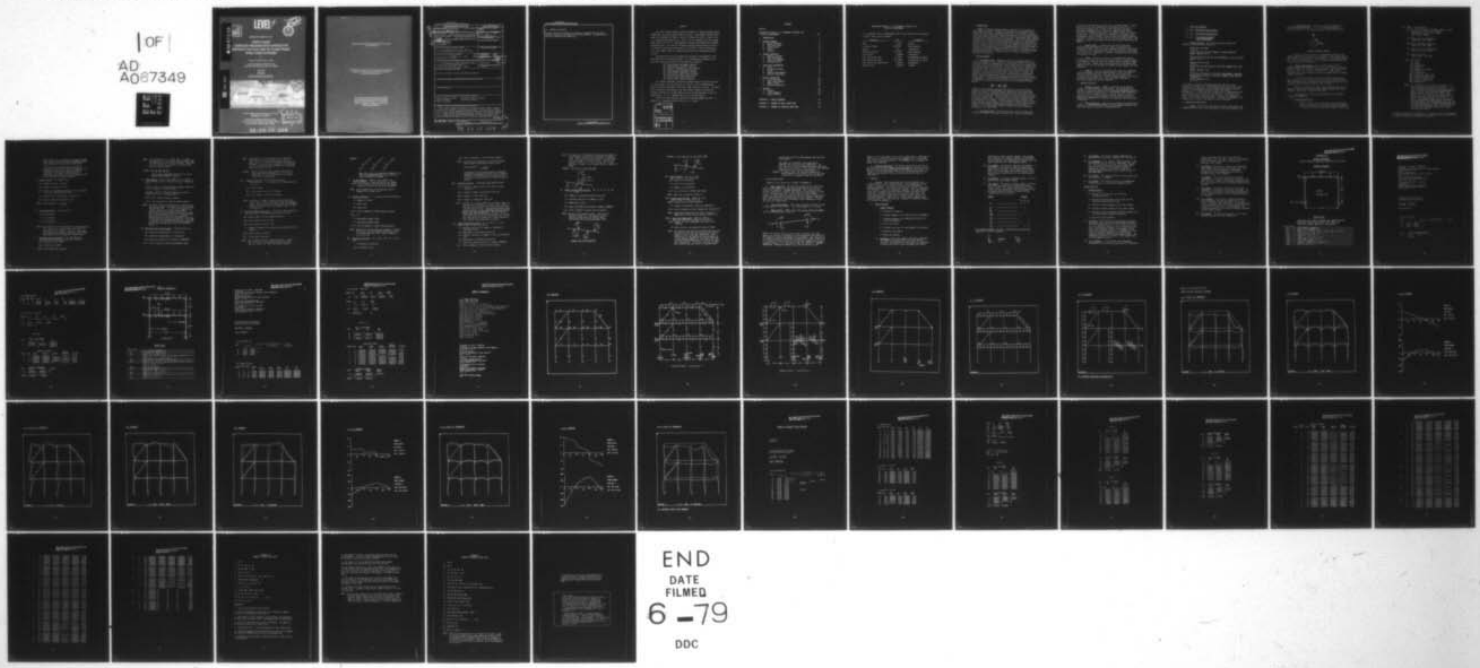

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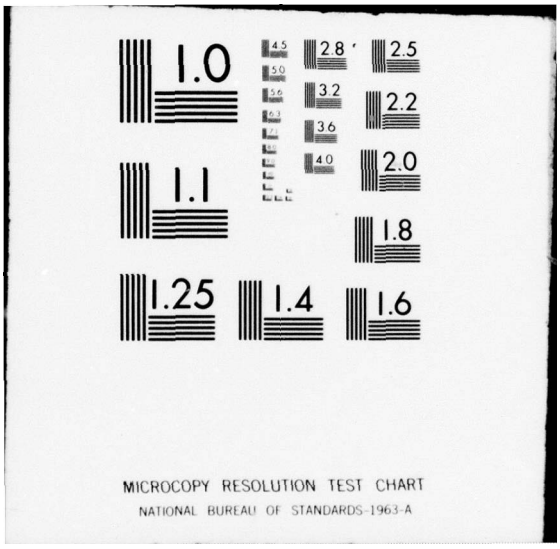
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INSTRUCTION REPORT O-79-2

USER'S GUIDE COMPUTER PROGRAM WITH INTERACTIVE GRAPHICS FOR ANALYSIS OF PLANE FRAME STRUCTURES (CFRAME)

by

Joseph P. Hartman, John J. Jobst

U. S. Army Engineer District, St. Louis
210 North 12th Street, St. Louis, Mo. 63101

March 1979
Final Report

Approved For Public Release; Distribution Unlimited

Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

Monitored by Automatic Data Processing Center
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

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Interactive computer graphics
Structural analysis

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report documents the usage of the general purpose computer program CFRAME for the analysis of plane frame structures. The intent was to develop an easy-to-use program incorporating the best features of many similar programs and to provide the many additional capabilities required by a diverse group of users. CFRAME utilizes the stiffness methods of structural analysis. The Cholesky decomposition method is used to solve the resulting matrix equation.

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20. ABSTRACT (Continued).

Automatic generation routines are available to simplify the data input. Graphical display of this input data is also available. The output may be printed or displayed with graphics.

PREFACE

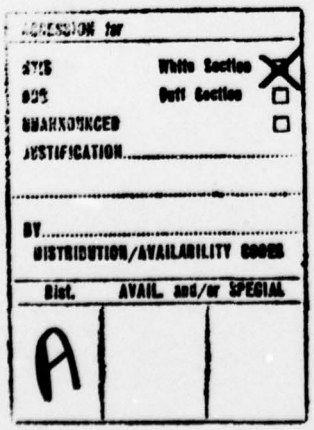
The User's Guide presented herein documents a computer program called CFRAME that can analyze plane frame structures. The program and this User's Guide were developed by Messrs. Joseph P. Hartman and John J. Jobst of the U. S. Army Engineer District, St. Louis, for the Automatic Data Processing (ADP) Center of the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss. The work was sponsored through funds provided to WES by the Military Construction Directorate of the Office, Chief of Engineers, U. S. Army (OCE), under the Computer-Aided Structural Engineering (CASE) project.

Specifications for the program were provided by the members of the CASE Task Group on Building Systems. The following were members of the Task Group during the period of developing this program:

Mr. Dan Reynolds, Sacramento District
Mr. Jerry Foster, Baltimore District
Mr. Joseph P. Hartman, St. Louis District
Mr. Sefton B. Lucas, Memphis District
Mr. James Simmons, Baltimore District
Mr. Ollie Werner, Middle East Division
Mr. Jun Ouchi, Pacific Ocean Division
Mr. Gene A. Wyatt, Mobile District
Mr. David Illias, Portland District

Mr. Seymour Schneider, Advanced Technology Branch, Military Construction Directorate, was the OCE point of contact. Dr. N. Radhakrishnan, Special Technical Assistant, ADP Center, WES, monitored the work. Mr. Wayne Jones, Computer-Aided Design Group, ADP Center, helped in getting the program converted to the WES computer and in getting the report ready for publication. Mr. D. L. Neumann was Chief of the ADP Center.

Director of WES during the period of this development was COL J. L. Cannon, CE. Technical Director was Mr. F. R. Brown.



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CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI)
UNITS OF MEASUREMENT

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
feet	0.3048	metres
foot-kips (force)	1355.818	metre-newtons
inches	2.54	centimetres
inch-kips (force)	112.9848	metre-newtons
kips (force)	4.448222	kilonewtons
kips (force) per foot	14.5939	kilonewtons per metre
kips (force) per inch	175.12685	kilonewtons per metre
kips (force) per square inch	6.894757	megapascals
pounds (force)	4.448222	newtons

1. INTRODUCTION

CFRAME is a general purpose computer program for the analysis of plane frame structures. CFRAME was developed for the Automatic Data Processing (ADP) Center, Waterways Experiment Station (WES). Specifications for the program were provided by members of the Building Systems Task Group under the Computer Aided Structural Engineering (CASE) project sponsored by the Office of Chief of Engineers. The intent was to develop an easy-to-use program incorporating the best features of many similar programs, and to provide the many additional capabilities required by a diverse group of users. Major portions of CFRAME were developed by the authors. However, several of the programming methods used were based on portions of the GFRAME program developed by Robert E. Brittain, U. S. Army Engineer District, Memphis, and on portions of the WILSON 2D-FRAME program developed by W. P. Doherty and E. L. Wilson, University of California at Berkeley.

2. PROGRAM SUMMARY

a. Analysis Method. CFRAME utilizes the stiffness methods of structural analysis. The properties of individual members were translated into member stiffnesses which include the effects of pinned ends plus shear and axial deformations. These stiffnesses are combined into a stiffness matrix for the entire structure which is then modified to account for fixed joints, elastic supports, and specified joint displacements. Also, for each load case, a load vector is formed, consisting of the effects of joint loads, concentrated and distributed member loads, and temperature loads. The load vector is modified to account for the effects of pin end members and the effects of specified displacements. In the stiffness method, the joint displacements are determined by multiplying the load vector by the inverted stiffness matrix:

$$[U] = [K]^{-1} [F]$$

CFRAME uses the Cholesky decomposition method to solve this matrix equation. The joint displacements are multiplied by the individual member stiffnesses to determine member end forces and moments. The end forces at restrained joints are summed to determine reaction forces acting on the structure. The end forces are used in conjunction with the applied member loads, to determine in-span shears, moments, and deflections for each member. In-span shears and deflections are calculated only when output graphics are requested. Further details of the stiffness method may be found in many textbooks on the subject, for example: J. S. Przmieniecki, Theory of Matrix Structural Analysis, McGraw-Hill, New York, 1968.

b. Structural Input. The user must input joint locations and fixities, and member locations and properties. Automatic generation

routines are available to simplify joint and member input. Joints may be fixed for any combination of horizontal, vertical, or rotational movement; may be elastically supported; may have a specified displacement; or may have any combination of these constraints. Members may be pinned (no moment transfer) at either or both ends. Axial deformations of members are included; shear deformations may be included. Multiple material properties may be specified. A variety of units may be used for the above input. The program is limited to problems with not more than 60 joints and 100 members.

c. Loading Input. A single load case may contain any combination of the following: joint loads, concentrated and distributed member loads, and gross temperature loads. The program is limited to 10 independent load cases. Ten additional load cases may be specified, consisting of factored combinations of the various independent load cases.

d. Output. Output may consist of any combination of the following: an input data echo of joints, members, or loads; joint displacements; structure reactions; member forces grouped by member or by load case. Member force output includes all end forces and moments as well as the minimum and maximum in-span moments and their locations.

e. Graphics. The user may display the input data including structure geometry, joint and member numbers, joint and member fixities, and applied loads. The user may also display the calculated shear, moment, and deflected shape diagrams of the entire structure for each load case. Shear and moment diagrams of individual members may also be displayed.

3. PROGRAM EXECUTION.

a. Computer Systems. CFRAME is available in timesharing through the CORPS system as program X0030. The CORPS system is available on the G635 computer at the Waterways Experiment Station (WES) in Vicksburg, Mississippi; on the Honeywell 6680 computer of the Civil Service Commission (CSC) in Macon, Georgia; and on the CDC7700 computer of Boeing Computer Services (BCS) in Seattle, Washington. CFRAME can be installed on computers other than those listed above.

b. Data Preparation. Input data requirements are detailed in SECTION 4 - INPUT DATA DESCRIPTION. Before program execution, the input data must be stored in a timesharing file.

c. Execution Commands.

(1) WES: #RUN WESLIB/CORPS/X0030,R

(2) CSC: #RUN WESLIB/CORPS/X0030,R

(3) BCS: C>OLD,CORPS/UN=CECELB
C>CALL,CORPS,X0030

d. Program Control. The user must provide appropriate responses to the following questions:

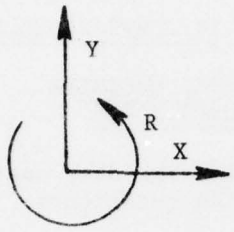
```
ENTER DATA FILE NAME
=IFILE
DO YOU WANT TO USE INPUT GRAPHICS, OUTPUT GRAPHICS?
ENTER 2 ANSWERS (Y/N)
=Y Y
DO YOU WANT OUTPUT WRITTEN TO THE TERMINAL, A FILE, OR BOTH?
ENTER T F OR B
=F
ENTER PRINT FILE NAME
=PFILE
DO YOU WANT AN INPUT ECHO OF JOINT DATA, MEMBER DATA, LOAD
DATA?
ENTER 3 ANSWERS (Y/N)
=Y Y Y
DO YOU WANT THE OUTPUT TO INCLUDE DISPLACEMENTS, REACTIONS,
MEMBER FORCES GROUPED BY LOAD CASE, MEMBER FORCES GROUPED
BY MEMBER?
ENTER 4 ANSWERS (Y/N)
=Y Y N Y
```

In the above responses, IFILE represents the name of a file containing the input data. PFILE represents the name of the output file which will contain all the requested input echo and analysis results. If PFILE does not exist, it will be created automatically. If PFILE exists, the user will be asked whether that file should be written over with the new data. If no print file name is entered and a carriage return is given, the program will revert to the output routing inquiry. If output is requested at the terminal only, a print file name will not be requested.

4. INPUT DATA DESCRIPTION.

a. Units. A variety of units may be used for input data. See paragraph 4e below for a full description of the units capabilities.

b. Coordinate System. The global coordinate system is an orthogonal right-hand system. It is used for displacements, structure reactions, joint coordinates, and applied joint forces.



GLOBAL COORDINATE SYSTEM

c. Format. Data should be in a timesharing file with line numbers and a blank following the line number. Free field format is used. Numerical data must be in an integer or a real number format; "E" format is not permitted. Input is limited to 80 characters per line, including the line number.

d. General Requirements. Where "list" appears in the following input data descriptions, it refers to a list of joints or members to which the previous input data apply. The "list" should be in the form: 3 8 10 TO 17 19 TO 23 27 . . ., where "TO" indicates all joints or members from the preceding to the following numbers, inclusive.

In the following input data descriptions, characters in quotation marks are an integral part of a given set of input data. Those characters must be included along with the numerical data; the quotation marks themselves should not be included.

Many lines of specific input data listed below may not be necessary to describe a given problem. When an input line is not required, simply omit it from the data file.

For examples of the above requirements, see the sample problems in APPENDIX A.

e. Specific Input Data.

I. Title. At least one line must be used for a problem title. Multiple title lines may be used by placing an "*" after each line of the title, except the last line.

II. Units. UE UJ UM UD UF

Can be omitted if consistent units are used

UE = Units for the modulus of elasticity (allowable units are "PSI", "PSF", "KSI", "KSF", "MPA")

UJ = Units for joint coordinates ("IN", "FT", "M", "CM")

UM = Units for member properties ("IN", "FT", "M", "CM")

UD = Units for joint displacements ("IN", "FT", "M", "CM")

UF = Units for forces ("LB", "KIP", "N", "KN")

Key:
- IN = inches
- FT = feet
- M = meters
- CM = centimeters
- LB = pounds
- KIP = kips (1,000 pounds) *
- N = newtons
- KN = kilonewtons
- PSI = pounds per square inch
- PSF = pounds per square foot
- KSI = kips per square inch
- KSF = kips per square foot
- MPA = megapascals

NOTE: Any combination of units may be specified. The joint coordinate units are also used for calculating member lengths, for specifying applied load locations, and for specifying magnitudes of applied moments and distributed loads. (For example, if UJ = FT and UF = LB, applied moments must be FT-LB and distributed loads must be LB/FT.) The member property units are also used for all member moment output and for structure reaction moments. The displacement units are used for spring constants, specified displacements, and calculated displacements. Force units are used for both input and output forces. All output includes units labels.

---

* A table of factors for converting U. S. customary units of measurement to metric (SI) units is presented on page iii.

If the units line is omitted, the program assumes that consistent units are used throughout and no units labels will be included in the output.

In addition to the above units which may be specified, several units may not be changed. All rotational units must be radians, except as indicated in the member load description. Consistent units must be used for temperature and the coefficient of thermal expansion.

III. Master Control. NJ NM NLC E POI

NJ = Number of joints (60 max)

NM = Number of members (100 max)

NLC = Number of independent load cases, not including load case combinations (10 max)

E = Default value for modulus of elasticity

POI = Default value for Poisson's ratio

NOTE: Shear modulus $G = \frac{E}{2(1+POI)}$

IV. Joint Coordinates. JN X Y, JN X Y, . . .

JN = Joint number

X = X coordinate

Y = Y coordinate

NOTE: Any number of joint coordinate sets may be grouped on a single line. Joints need not be input in numerical order. However, after all joint input and automatic generation is complete, joints must have numbers from 1 through NJ, consecutively.

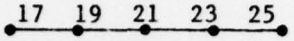
V. Automatic Joint Generation. "GJ" JNA JNB INCR
Can be omitted if no joint generation is desired.

JNA = Beginning joint number

JNB = Ending joint number

INCR = Joint numbering increment

NOTE: Joint numbers JNA + 1 x INCR, JNA + 2 x INCR, . . . are generated at equal spaces between JNA and JNB. JNA and JNB must be previously defined. More than one "GJ" command may be given on a single line. This line may be omitted.

Example: 

GJ 17 25 2 generates joints 19, 21, 23 at equal spaces between 17 and 25.

VI. Joint Fixity. "FIX X" list, "FIX Y" list, "FIX R" list, "FIX KX" KX list, "FIX KY" KY list, "FIX KR" KR list

"FIX X", "FIX Y", "FIX R" indicate complete fixity for X, Y, or R motion of listed joints

"FIX KX", "FIX KY", "FIX KR" indicate an elastic support for X, Y, or R displacements

KX, KY, KR = Elastic support constant

list = List of joints to which the fixity applies

NOTE: The above input may be grouped on a single line or on multiple lines. The "list" is of the form JNA JNB JNC "TO" JND . . ., where "TO" indicates all joints between and including JNC and JND. Sufficient joint fixity must be specified to make the structure stable against X, Y, and R motions. Other portions of this line may be omitted. Different spring constants at different joints may be specified by repeating "FIX KX", etc., as often as required. No more than 20 different magnitudes may be specified for KX, for KY, or for KR (60 total).

VII. Specified Joint Displacements. "SD" DX DY DR list

DX = Specified displacement in +X direction

DY = Specified displacement in +Y direction

DR = Specified rotation in +R direction (RADIANS)

list = List of joints to which displacements apply

NOTE: Displacements to be specified as zero should be indicated in the joint fixity input. (Item VI) When a zero is included in the specified joint displacement input, the zero is ignored. No more than 20 sets of specified displacements may be included. This line may be omitted.

Example: SD 0. -1.5 0. 17 would indicate that joint 17 had a specified displacement of -1.5 in the Y direction, but that it was still free to move in the X and R directions.

VIII. Member Incidences. MN JNA JNB, MN JNA JNB, . . .
Can be omitted if all members can be generated (see Item IX)

MN = Member number

JNA = Joint number at end "A" of member

JNB = Joint number at end "B" of member

NOTE: Any number of member incidences may be input on a single line. Members need not be input in numerical order. However, after all member input and automatic generation, members must have numbers from 1 to NM, consecutively.

IX. Automatic Member Generation. "GM" MN JNA JNB N INCM INCJ
Can be omitted, if no member generation is desired.

MN = Member number of first member generated

JNA = Joint number at end A of Mn

JNB = Joint number at end B of MN

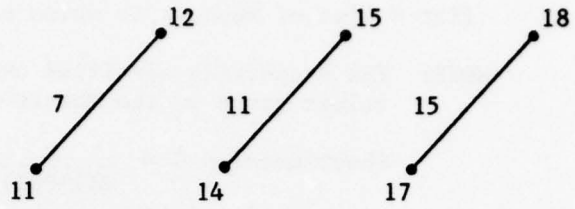
N = Number of members to be generated (including the first member)

INCM = Member number increment

INCJ = Joint number increment

NOTE: This command generates members MN, MN + 1 x INCM, . . . The end joints of the generated members are JNA, JNA + 1 x INCJ, etc. This line may be omitted.

Example:



GM 7 11 12 3 4 3 generates members 7, 11, and 15 by adding multiples of 3 to the end joints specified for member 7.

X. Pin End Members. "PIN A" list, "PIN B" list
Can be omitted if no pin end members are present.
list = List of members which have a pin (no moment transfer) at end A (or end B) of the member

NOTE: These commands may be on separate lines or combined on a single line.

XI. Member Properties. I A AS list (or) Zero B H list

I = Moment of inertia

A = Axial area

AS = Shear area

list = List of members to which properties apply

Zero = 0.

B = Rectangular member width

H = Rectangular member depth

list = List of members to which properties apply

NOTE: Repeat this line as often as necessary. B and H are used to calculate member properties if the first data item is a zero. Then $I = BH^3/12$, $A = AS = B \times H$.

XII. Material Properties. "E" E POI list, "E" E POI list, . . .

E = Modulus of elasticity

POI = Poisson's ratio

list = List of members to which material applies

NOTE: The properties specified override the default values given on the Master Control line.

Shear modulus $G = \frac{E}{2(1+POI)}$

In addition to the default material properties specified on the Master Control line, as many as 4 material properties may be specified, all on one line or on separate lines. This line may be omitted.

XIII. Load Case Control. "LOAD CASE" NDLS NCLS NJLS NTLS

NDLS = Number of member distributed loads for this load case

NCLS = Number of member concentrated load sets

NJLS = Number of joint load sets

NTLS = Number of temperature load sets

NOTE: If NTLS = 0, it may be omitted. If NTLS = NJLS = 0, they may both be omitted. If NTLS = NJLS = NCLS = 0, they may all be omitted from the data and will have a default value of zero. One Load Case Control line must be included at the beginning of each load case, except load case combinations. No more than 10 independent load cases may be specified. For each load case input XIII and as appropriate XIV, XV, XVI, XVII immediately following XIII. During execution each of these load cases will be solved.

XIV. Member Distributed Loads. LA PA LB PB Φ list
Omit if NDLS = 0 (see Item XIII)

LA = Distance from end A of member to beginning of distributed load

PA = Magnitude of distributed load at LA

LB = Distance from end A of member to end of distributed load.

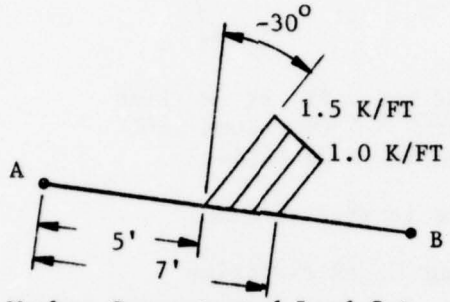
PB = Magnitude of distributed load at LB

Φ = Angle load makes with normal to member (DEGREES)

list = List of members to which load set applies

NOTE: Any number of distributed load sets may be applied to a given member to adequately represent any complex load. Sign conventions are identical to those shown below for member concentrated loads. This line is omitted if NDLS = 0. If PA = PB, and LA = 0, and LB<length of member, then program sets LB = length of member.

Example: 5. 1.5 7. 1.0 -30. list



XV. Member Concentrated Load Set. NL L1 P1 Φ1, L2 P2 . . ., list

NL = Number of concentrated loads in the set

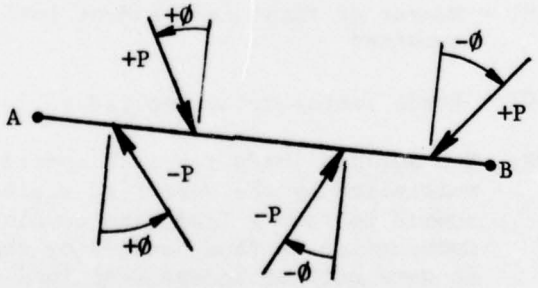
L1 = Distance from end A of member to load

P1 = Magnitude of load

Ø1 = Angle load makes with normal to member (DEGREES)

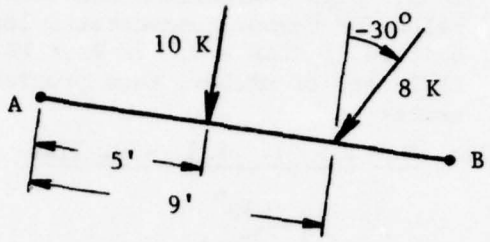
list = List of members to which load set applies

NOTE: NL must not be greater than 5. This line is omitted if NCLS = 0. The member load sign convention shown below is used for both concentrated and distributed member loads.



MEMBER LOAD SIGN CONVENTION

Example: 2 5. 10. 0. 9. 8. -30. list



XVI. Joint Load Set. PX PY M list
Omit if NTLS = 0 (See Item XIII)
PX = Force in +X direction

PY = Force in +Y direction

M = Moment in +R direction

list = List of joints to which loads apply

NOTE: This line is omitted if NJLS = 0.

XVII. Temperature Load Set. ALPHA DT list
Omit if NTLS = 0 (See Item XIII)
ALPHA = Coefficient of themal expansion

DT = Change in temperature from base temperature

list = List of members to which temperature load applies

NOTE: Consistent temperature units must be used for ALPHA and DT. This line is omitted if NTLS = 0.

XVIII. Load Case Combination. LCN1 C1, LCN2 C2, . . .
Omit if no load case combination is desired.
LCN1 = Number of first independent load case to be combined

C1 = Scale factor to be applied to loads of LCN1

NOTE: The applied loads for each specified load case are multiplied by the specified scale factor and are summed to form a load case combination. This combination is then handled by the program as if it were another independent load case. Note that specified displacements are not affected by load case combinations. Therefore, care must be taken when interpreting the results of analyses which

include both specified displacements and load case combinations.

Any number of independent load cases may be combined into a new load case combination. No more than 10 load case combinations may be specified. This line may be omitted. Each specified load case and combination will be solved independently.

Example: 2 1.0 3 -0.5 The load case combination would consist of the applied loads of load case 2 minus half the applied loads of load case 3.

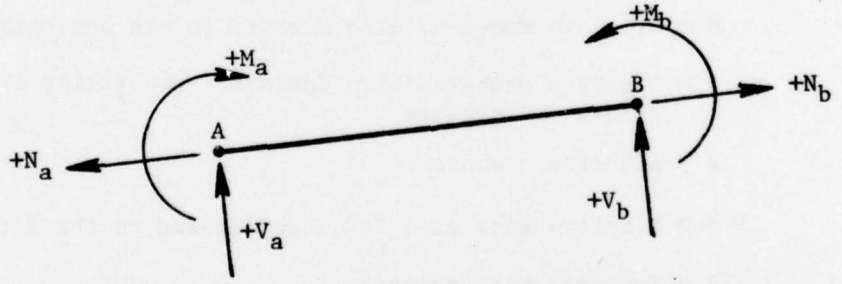
5. OUTPUT DESCRIPTION.

Examples of all output are included in APPENDIX A.

a. Input Data Echo. The user may specify that an input data echo of joint, member, or load data be included as part of the output (see SECTION 3 - PROGRAM EXECUTION). The joint data echo includes coordinates, fixities, and specified displacements of each joint. The member data echo includes the end joints, member lengths, section properties, and pin ends; pin ends are indicated by minus signs preceding the appropriate end joint numbers. The load data echo includes all joint and member loads, temperature loads, and load case combinations.

b. Joint Displacements. This output consists of the X, Y, and R displacements of all joints. The R displacement is in radians.

c. Member Forces. Member forces act on the end of the member, with the following sign convention:



Member force output consists of all these end forces, the joint numbers at each end of the member, and the magnitude and location of the algebraic maximum and minimum in-span moments. The locations of the moment extrema are indicated by printing the distance from end A of the member to the location of each extreme. Member forces may be grouped by member or by load case or both (see SECTION 3 - PROGRAM EXECUTION). Grouping by member will cause the forces for one

member, for all load cases, to be output consecutively. Grouping by load case will cause the forces for all members, for a single load case, to be output consecutively. See APPENDIX A for an example of member force grouping.

d. Structure Reactions. The printed reactions are the +X, +Y, and +R direction forces acting on the structure at any fixed joint. Reactions have the same sign convention as applied joint loads. For example, if the total applied load in the X direction was 500, the total reaction should be -500, so that the sum of all forces is +500-500 = 0.

6. GRAPHICS.

a. General. Both input graphics and output graphics are available as part of the CFRAME program. The program asks whether either of these will be used during each run (see SECTION 3 - PROGRAM EXECUTION). The graphics are available only on a Tektronix 4014 terminal or on a 4014 compatible terminal. The input graphics serve only to display data which has previously been saved in an input file. Graphics cannot be used to create input data. The output graphics may be used only to display certain results of a successful analysis. These results include shears, moments, and deflected shapes for each load case. Examples of graphics displays are included in APPENDIX A.

b. Input Graphics.

I. Command Summary.

D = Displays all members

N = Displays members, also numbers joints and members

F = Displays members, also indicates the fixity of joints and members

A = All of the above

L n = Displays load case "n" superimposed on the frame

E = Executes the analysis

S = Stops the program

II. Procedure. Once input graphics have been requested, the remaining program control questions must be answered. The program will then print, if requested, an input data echo of joint and member data before

requesting an input graphics command. The program will construct the requested display and then await another command. Any command may be given at any time until either an "E" or "S" command is given.

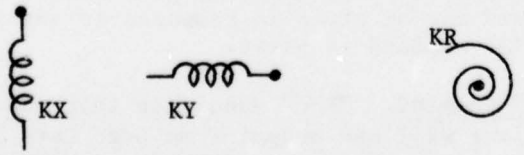
III. "D" Command. "D" causes a display of all members. A scale size is calculated so that the display will nearly fill the screen. The display is oriented so that +X is to the right and +Y is to the top. This basic display is used for all of the input graphics displays.

IV. "N" Command. "N" causes a display similar to "D" but adds all joint and member numbers.

V. "F" Command. "F" causes a display similar to "D" but adds joint and member fixity symbols and elastic support values. Pin ends are indicated by a small circle near the appropriate end of each member. The following symbols are used to indicate various combinations of joint fixity:

SYMBOL	FIXITY		
	X	Y	R
	*	*	*
	*	*	
		*	
	*		
			*
	*		*
		*	*

The following symbols are used to indicate the locations and magnitudes of elastic supports:



VI. "A" Command. "A" causes a display combining the features of all the above commands, "D", "N", and "F".

VII. "L n" Command. "L n" causes a display similar to "D" but adds the applied loads for independent load case "n". The load display includes joint loads, member distributed and concentrated loads, and member temperature changes. The loads are drawn in an unscaled size but magnitudes are printed adjacent to the load symbol.

VIII. "E" Command. "E" causes execution of the analysis and output portion of CFRAME.

IX. "S" Command. "S" stops the execution of CFRAME and returns the user to the normal timesharing mode.

c. Output Graphics.

I. Command Summary.

L n = Specifies the load case to be used for subsequent displays

D = Displays deflected shape of the frame for the *previously specified load case*

V = Displays a shear diagram for the entire frame

M = Displays a moment diagram for the entire frame

I m = Displays a shear and moment diagram for member "m" for the previously specified load case

S = Stops the output graphics

II. Procedure. After printing all requested output data, the program will request an output graphics command. The first command should be "L n" to specify the load case for subsequent displays, until a different load case is specified by another "L n" command. After this initial command is given, the program will then prompt for another command, will construct the requested display, and will give another prompt. Any command may be given in response to any prompt until the "S" command is given.

III. "L n" Command. "L n" specifies that subsequent displays will use output from Load Case "n", which may

be any independent load case or any load case combination. This load case is used for all displays until a different load case is specified by a subsequent "Ln" command.

IV. "D" Command. "D" causes a display of the deflected shape of the frame for the current load case. The scale factor for displacements is determined automatically by the program and a bar scale is included as part of the display.

V. "V" Command. "V" causes a display of the shear diagram for the frame for the current load case. The scale factor for shears is determined automatically by the program and a bar scale is included as part of the display.

VI. "M" Command. "M" causes a display of the moment diagram for the frame for the current load case. The scale factor for moments is determined automatically by the program and a bar scale is included as part of the display.

VII. "I m" Command. "I m" causes a combined display of shear and moment diagrams for member "m" for the current load case. Each member has a scale factor for shears and moments which is computed automatically and is used for all load cases for that member. The ordinate and abscissa of the shear and moment diagrams include labeled scales.

VIII. "S" Command. "S" stops the execution of the output graphics and ends the entire CFRAME run.

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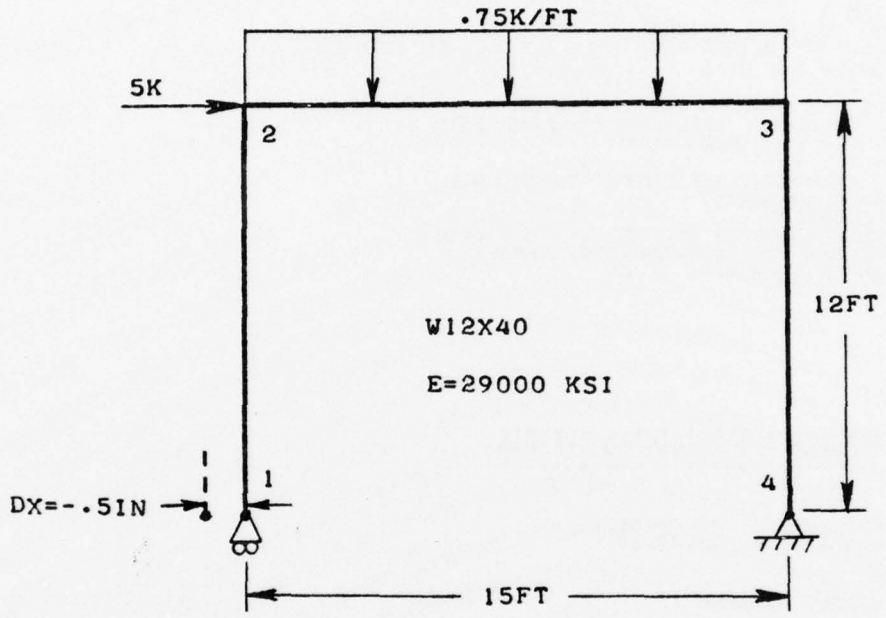
APPENDIX A

SAMPLE PRØBLEMS

(RUN ØN BØEING CØMPUTER SERVICES CDC CYBER175

SAMPLE PRØBLEM 1



INPUT DATA

NØTE THAT THE UNITS CØMMAND HAS BEEN ØMITTED
THEREFØRE CØNSISTENT UNITS ARE USED AND
NØ UNITS LABELS APPEAR IN THE ØUTPUT

Data Group	
I	0100 SAMPLE PRØBLEM 1
III	0110 4 3 1 29000. .3
IV	0120 1 0. 0. 2 0. 144. 3 180. 144. 4 180. 0.
VI	0130 FIX X 4 FIX Y 1 4
VII	0140 SD -.5 0. 0. 1
VIII	0150 1 1 2 2 2 3 3 3 4
XI	0160 310. 11.8 0. 1 2 3
XIII	0170 LØAD CASE 1 0 1
XIV	0180 0. .0625 180. .0625 0. 2
XVI	0190 5. 0. 0. 2

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```
ENTER DATA FILE NAME--7 CHARS MAX
I>SAMPLE1
DO YOU WANT TO USE INPUT GRAPHICS, OUTPUT GRAPHICS ?
ENTER 2 ANSWERS (Y/N)
I>N N
DO YOU WANT OUTPUT
WRITTEN TO THE TERMINAL, A FILE, OR BOTH ?
ENTER T F OR B
I>T
DO YOU WANT AN INPUT ECHO OF
JOINT DATA, MEMBER DATA, LOAD DATA ?
ENTER 3 ANSWERS (Y/N)
I>Y Y Y
DO YOU WANT THE OUTPUT TO INCLUDE
DISPLACEMENTS,
REACTIONS,
MEMBER FORCES GROUPED BY LOAD CASE,
MEMBER FORCES GROUPED BY MEMBER ?
ENTER 4 ANSWERS (Y/N)
I>Y Y Y N
```

```
PROGRAM CFRAME V01.00 01SEP78

RUN DATE =  78/09/01.
RUN TIME =  05.44.10.

SAMPLE PROBLEM 1
```

*** JOINT DATA ***

JOINT	X	Y	FIXITY X	FIXITY Y	FIXITY R	KX	KY	KR
1	0.00	0.00		◆				
2	0.00	144.00						
3	180.00	144.00						
4	180.00	0.00	◆	◆				

SPECIFIED DISPLACEMENTS

JOINT	DX	DY	DR
1	-.5000E+00		

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*** MEMBER DATA ***

MEMBER	END A	END B	LENGTH	I	A	AS	E	G
1	1	2	144.00	310.00	11.80	0.00	.2900E+05	.1115E+05
2	2	3	180.00	310.00	11.80	0.00	.2900E+05	.1115E+05
3	3	4	144.00	310.00	11.80	0.00	.2900E+05	.1115E+05

*** LOAD CASE 1 DATA ***

MEMBER	LA	PA	LB	PB	ANGLE
2	0.00	.6250E-01	180.00	.6250E-01	0.00

JOINT	FORCE X	FORCE Y	MOMENT
2	.5000E+01	0.	0.

LOAD CASE 1

JOINT DISPLACEMENTS

JOINT	DX	DY	DR
1	-.5000E+00	0.	-.5853E-02
2	.2031E+00	-.6838E-03	-.2943E-02
3	.2018E+00	-.4050E-02	.5028E-03
4	0.	0.	-.2354E-02

MEMBER END FORCES

MEMBER	JOINT	AXIAL	SHEAR	MOMENT	MOMENT EXTREMA	LOCATION
1	1	-.1625E+01	.2523E+01	0.	.3633E+03	144.00
	2	-.1625E+01	-.2523E+01	.3633E+03	0.	0.00
2	2	-.2477E+01	.1625E+01	.3633E+03	.3844E+03	25.20
	3	-.2477E+01	.9625E+01	-.3567E+03	-.3567E+03	180.00
3	3	-.9625E+01	.2477E+01	-.3567E+03	0.	144.00
	4	-.9625E+01	-.2477E+01	0.	-.3567E+03	0.00

STRUCTURE REACTIONS

JOINT	FORCE X	FORCE Y	MOMENT
1	-.2523E+01	.1625E+01	0.
4	-.2477E+01	.9625E+01	0.
TOTAL	-.5000E+01	.1125E+02	

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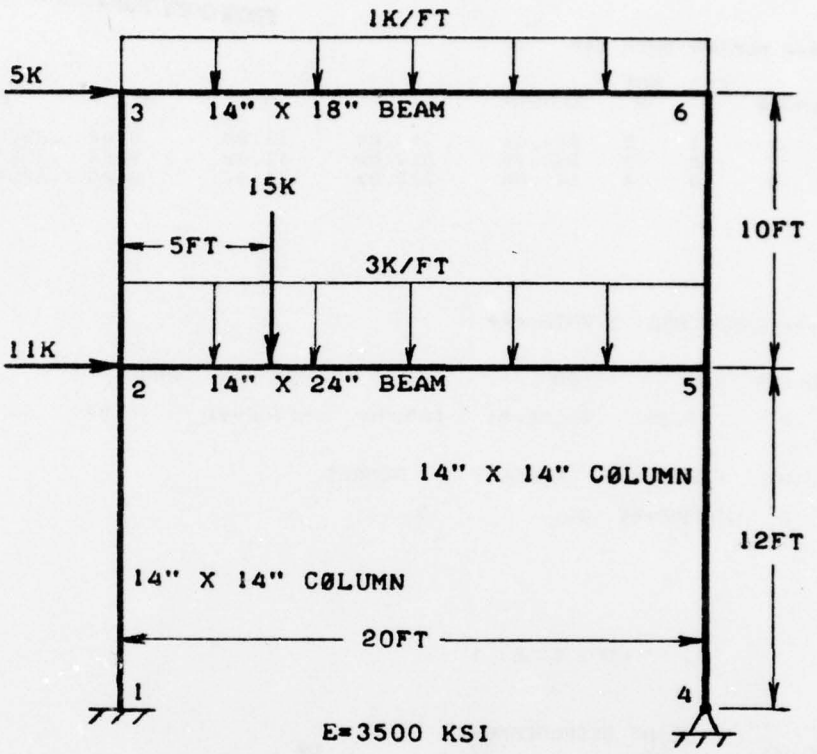
SAMPLE PRØBLEM 2



INPUT DATA

Data Group	
I	0100 SAMPLE PRØBLEM 2
II	0110 KSI FT IN IN KIP
III	0120 6 6 1 3500. .15
	0130 1 0. 0. 2 0. 12. 3 0. 22. 4 20. 0.
IV	0140 5 20. 12. 6 20. 22.
VI	0150 FIX X 1 4 FIX Y 1 4 FIX R 1
VIII	0160 1 1 2 2 2 3 3 4 5 4 5 6 5 2 5 6 3 6
	0170 0 14 14 1 TØ 4
	0180 0 14 24 5
XI	0190 0 14 18 6
XIII	0200 LØAD CASE 2 1 2
	0210 0. 3. 20. 3. 0. 5
XIV	0220 0. 1. 20. 1. 0. 6
XV	0230 1 5. 15. 0. 5
	0240 11. 0. 0. 2
XVI	0250 5. 0. 0. 3

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```
ENTER DATA FILE NAME--7 CHARS MAX
I>SAMPLE2
DO YOU WANT TO USE INPUT GRAPHICS, OUTPUT GRAPHICS ?
ENTER 2 ANSWERS (Y/N)
I>N N
DO YOU WANT OUTPUT
WRITTEN TO THE TERMINAL, A FILE, OR BOTH ?
ENTER T F OR B
I>T
DO YOU WANT AN INPUT ECHO OF
JOINT DATA, MEMBER DATA, LOAD DATA ?
ENTER 3 ANSWERS (Y/N)
I>Y Y Y
DO YOU WANT THE OUTPUT TO INCLUDE
DISPLACEMENTS,
REACTIONS,
MEMBER FORCES GROUPED BY LOAD CASE,
MEMBER FORCES GROUPED BY MEMBER ?
ENTER 4 ANSWERS (Y/N)
I>Y Y Y N
```

```
*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*
PROGRAM CFRAME V01.00 01SEP78
*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*
```

```
RUN DATE =  78/09/01.
RUN TIME =  09.33.53.
```

SAMPLE PROBLEM 2

*** JOINT DATA ***

JOINT	X	Y	FIXITY X	FIXITY Y	FIXITY R	KX	KY	KR
	FT	FT				KIP/IN	KIP/IN	IN-KIP/RAD
1	0.00	0.00	*	*	*			
2	0.00	12.00						
3	0.00	22.00						
4	20.00	0.00	*	*				
5	20.00	12.00						
6	20.00	22.00						

*** MEMBER DATA ***

MEMBER	END A	END B	LENGTH FT	I IN**4	A IN**2	AS IN**2	E KSI	G KSI
1	1	2	12.00	3201.33	196.00	196.00	.3500E+04	.1522E+04
2	2	3	10.00	3201.33	196.00	196.00	.3500E+04	.1522E+04
3	4	5	12.00	3201.33	196.00	196.00	.3500E+04	.1522E+04
4	5	6	10.00	3201.33	196.00	196.00	.3500E+04	.1522E+04
5	2	5	20.00	16128.00	336.00	336.00	.3500E+04	.1522E+04
6	3	6	20.00	6804.00	252.00	252.00	.3500E+04	.1522E+04

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*** LOAD CASE 1 DATA ***

MEMBER	LA FT	PA KIP/FT	LB FT	PB KIP/FT	ANGLE DEG
5	0.00	.3000E+01	20.00	.3000E+01	0.00
6	0.00	.1000E+01	20.00	.1000E+01	0.00

MEMBER	L FT	P KIP	ANGLE DEG
5	5.00	.1500E+02	0.00

JOINT	FORCE X KIP	FORCE Y KIP	MOMENT FT-KIP
2	.1100E+02	0.	0.
3	.5000E+01	0.	0.

LOAD CASE 1

JOINT DISPLACEMENTS

JOINT	DX IN	DY IN	DR RAD
1	0.	0.	0.
2	.3973E+00	-.9012E-02	-.2340E-02
3	.4951E+00	-.1049E-01	-.5401E-03
4	0.	0.	-.4570E-02
5	.3983E+00	-.1093E-01	.9029E-03
6	.4922E+00	-.1295E-01	-.1150E-03

MEMBER END FORCES

MEMBER	JOINT	AXIAL KIP	SHEAR KIP	MOMENT IN-KIP	MOMENT EXTREMA IN-KIP	LOCATION IN
1	1	-.4293E+02	.1008E+02	-.9082E+03	.5440E+03	144.00
	2	-.4293E+02	-.1008E+02	.5440E+03	-.9082E+03	0.00
2	2	-.8446E+01	-.5656E+01	.5074E+03	.5074E+03	0.00
	3	-.8446E+01	.5656E+01	-.1713E+03	-.1713E+03	120.00
3	4	-.5207E+02	.5915E+01	0.	.8518E+03	144.00
	5	-.5207E+02	-.5915E+01	.8518E+03	0.	0.00
4	5	-.1155E+02	.1066E+02	-.7344E+03	.5443E+03	120.00
	6	-.1155E+02	-.1066E+02	.5443E+03	-.7344E+03	0.00
5	2	.4741E+01	.3449E+02	.3662E+02	.1696E+04	76.80
	5	.4741E+01	.4051E+02	-.1586E+04	-.1586E+04	240.00
6	3	-.1066E+02	.8446E+01	-.1713E+03	.2567E+03	100.80
	6	-.1066E+02	.1155E+02	-.5443E+03	-.5443E+03	240.00

STRUCTURE REACTIONS

JOINT	FORCE X KIP	FORCE Y KIP	MOMENT IN-KIP
1	.1008E+02	.4293E+02	.9082E+03
4	-.5915E+01	.5207E+02	0.
TOTAL	-.1600E+02	.9500E+02	

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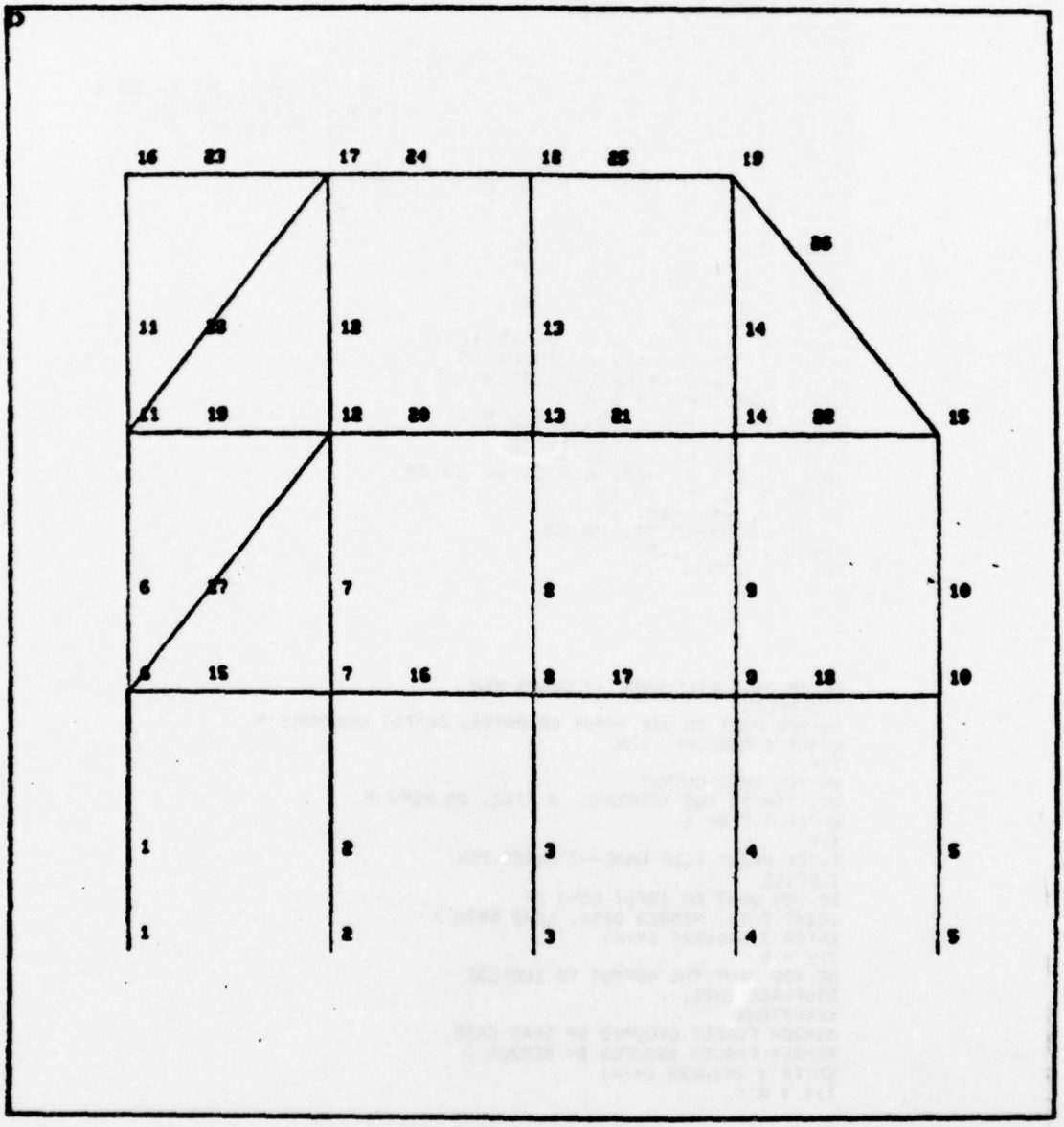
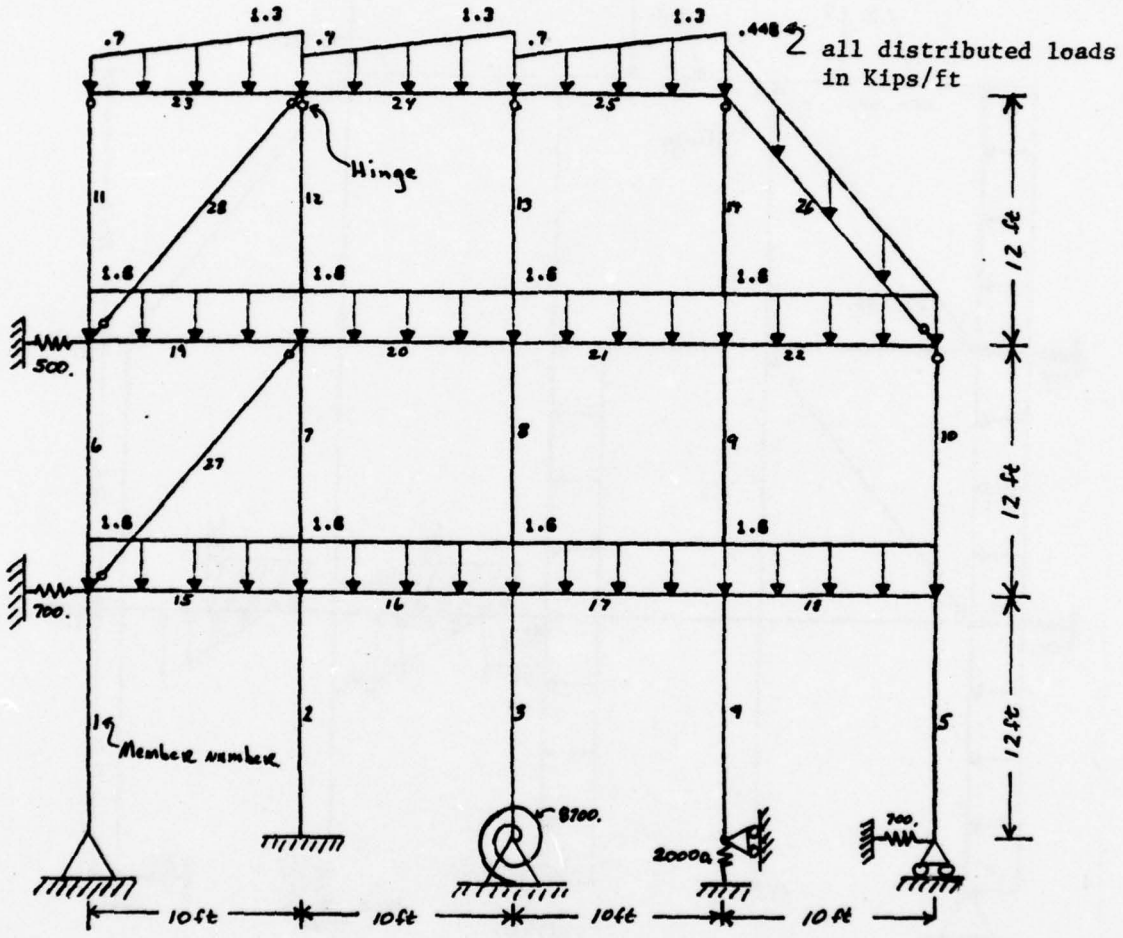
SAMPLE PROBLEM 3

```
00100 SAMPLE PROBLEM 3*
00110 THREE STORY FRAME
00120 KSI FT IN IN KIP
00130 19 28 2 29000. .3
00140 1 0. 0.  5 40. 0.  19 30. 36.
00150 16 0. 36.  15 40. 24.  10 40. 12.
00160 GJ 1 16 5  GJ 1 5 1  GJ 6 10 1  GJ 11 15 1  GJ 16 19 1
00170 FIX X 1 TO 4  FIX Y 1 2 3 5  FIX R 2  FIX KR 8700. 3
00180 FIX KX 700. 5 6  FIX KX 500. 11  FIX KY 20000. 4
00190 26 19 15  27 6 12  28 11 17
00200 GM 1 1 6 14 1 1  GM 15 6 7 4 1 1
00210 GM 19 11 12 4 1 1  GM 23 16 17 3 1 1
00220 PIN A 27 28  PIN B 10 TO 14 26 27 28
00230 96.3 5.61 0. 1 TO 14
00240 156. 6.47 0. 15 TO 22
00250 68.9 4.41 0. 23 TO 26
00260 2.49 9.80 0. 27 28
00270 E 30000. .33 23 TO 26
00280 LOAD CASE 3
00290 0. 1.6  10. 1.6  0. 15 TO 22
00300 0. .7 10. 1.3 0. 23 24 25
00310 0. .448 15.62 .448 50.19 26
00320 LOAD CASE 3 1 2 1
00330 0. .4 12. .4 0. 1 3 6 8 11
00340 2. .4 6. .4 20. 17 18
00350 3. 0. 8. -.3 0. 17 18
00360 2 3.3 2. -20. 6.7 3. 0. 23 24
00370 3. 0. 0. 10 15
00380 0. -5. -18. 19
00390 .0000065 50. 28 23
00400 1 1. 2 1.5
00410 1 .75 2 -.5
```

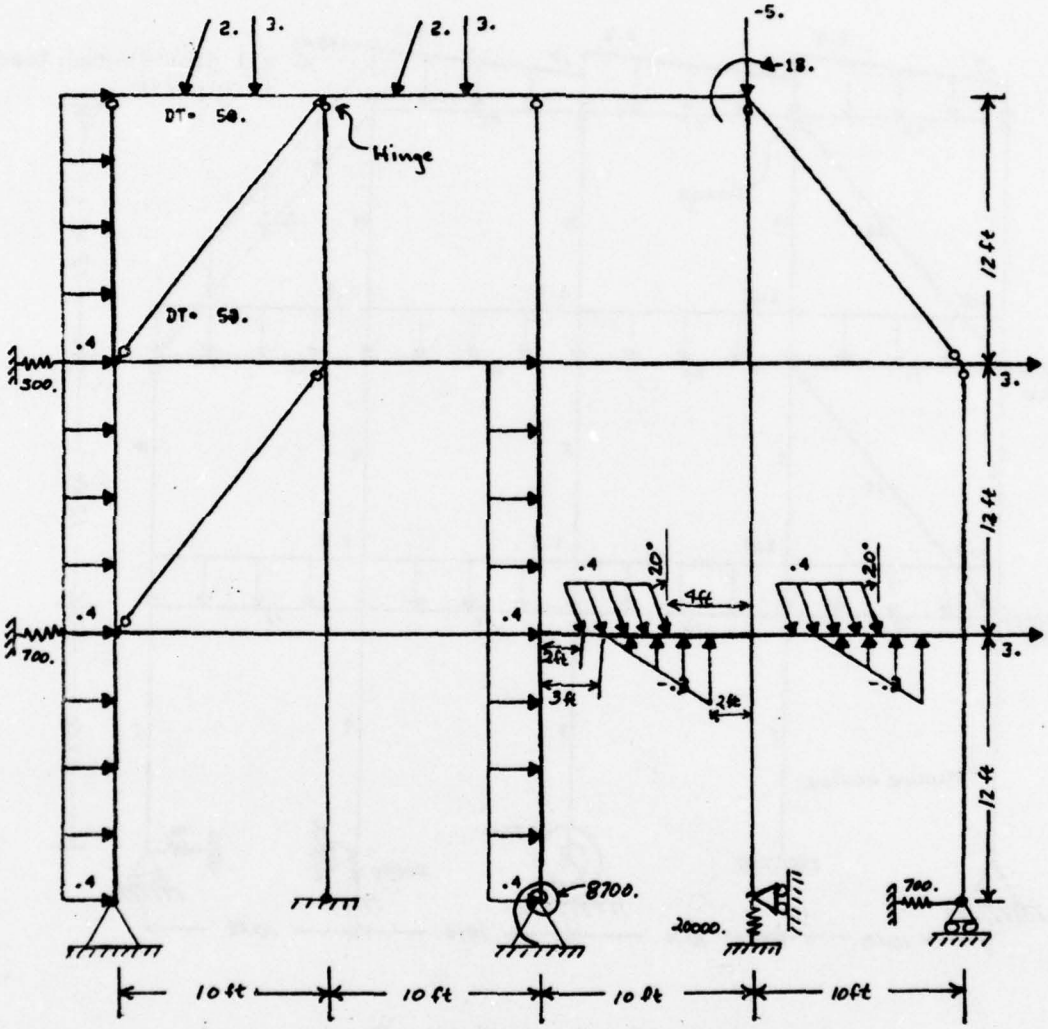
```
ENTER DATA FILE NAME--7 CHARS MAX
I>SAMPLE3
DO YOU WANT TO USE INPUT GRAPHICS, OUTPUT GRAPHICS ?
ENTER 2 ANSWERS (Y/N)
I>Y Y
DO YOU WANT OUTPUT
WRITTEN TO THE TERMINAL, A FILE, OR BOTH ?
ENTER T F OR B
I>F
ENTER PRINT FILE NAME--7 CHARS MAX
I>PFILE
DO YOU WANT AN INPUT ECHO OF
JOINT DATA, MEMBER DATA, LOAD DATA ?
ENTER 3 ANSWERS (Y/N)
I>Y Y Y
DO YOU WANT THE OUTPUT TO INCLUDE
DISPLACEMENTS,
REACTIONS,
MEMBER FORCES GROUPED BY LOAD CASE,
MEMBER FORCES GROUPED BY MEMBER ?
ENTER 4 ANSWERS (Y/N)
I>Y Y N Y

ENTER INPUT GRAPHICS COMMAND
I>N
```

"N" COMMAND


16 23 17 24 18 25 19
26
11 22 18 13 14
11 19 12 20 13 21 14 22 15
6 17 7 8 9 10
6 15 7 16 8 17 9 18 10
1 2 3 4 5
1 2 3 4 5

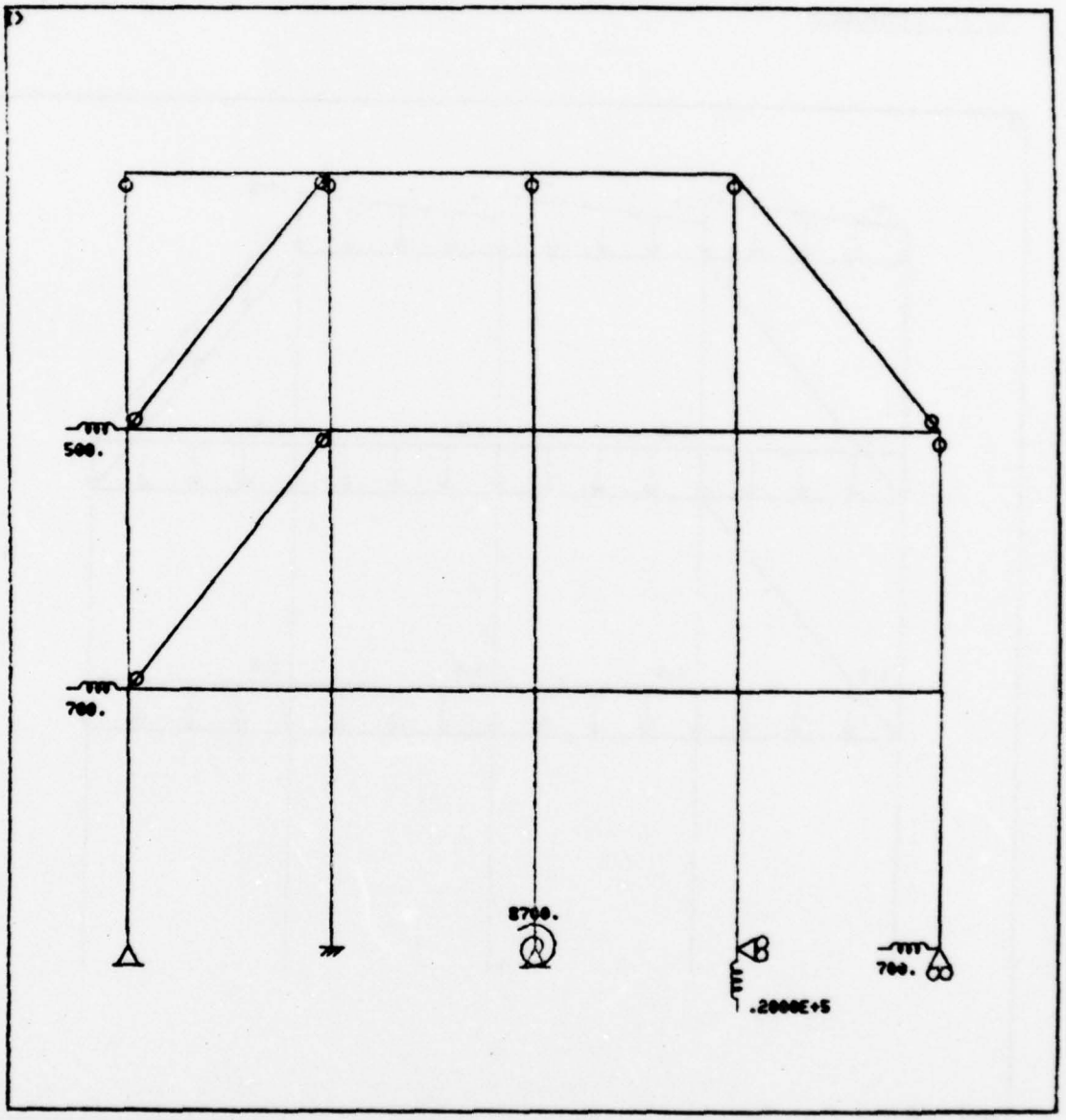


Example Problem 3 - Load Case No. 1

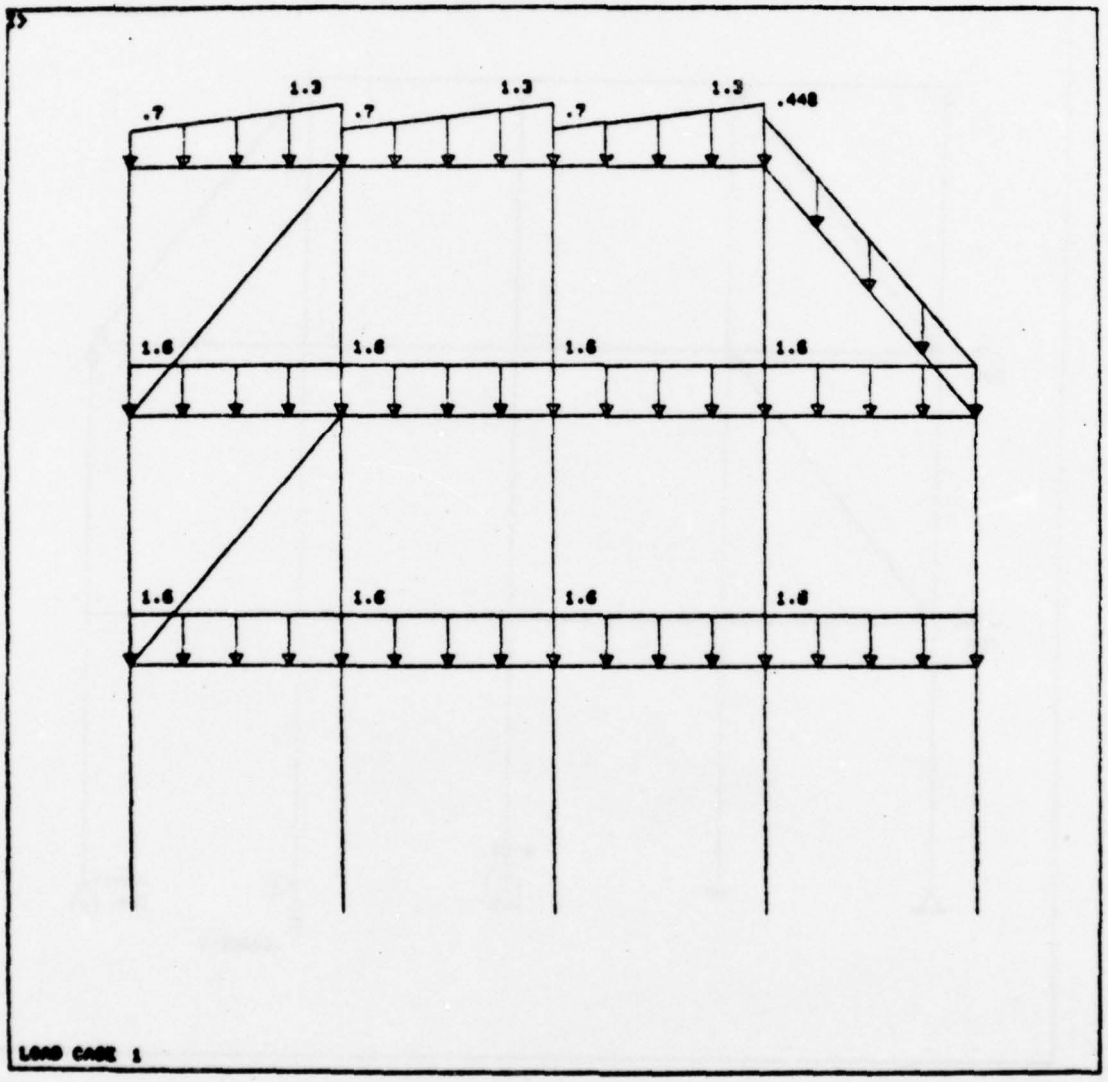


Example Problem 3 - Load Case No. 2

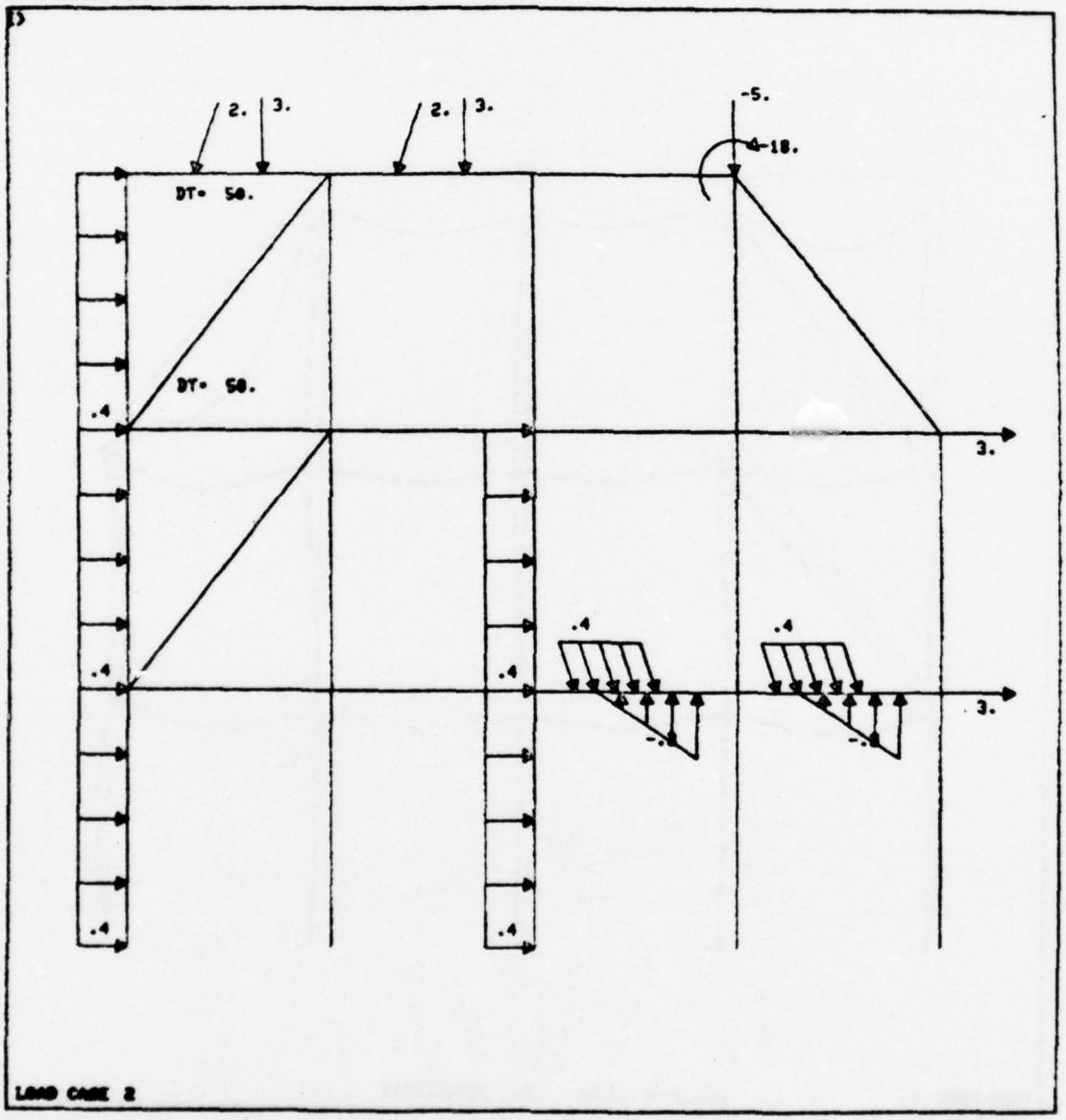
"F" CØMMAND



"L 1" CØMMAND



"L 2" CØMMAND

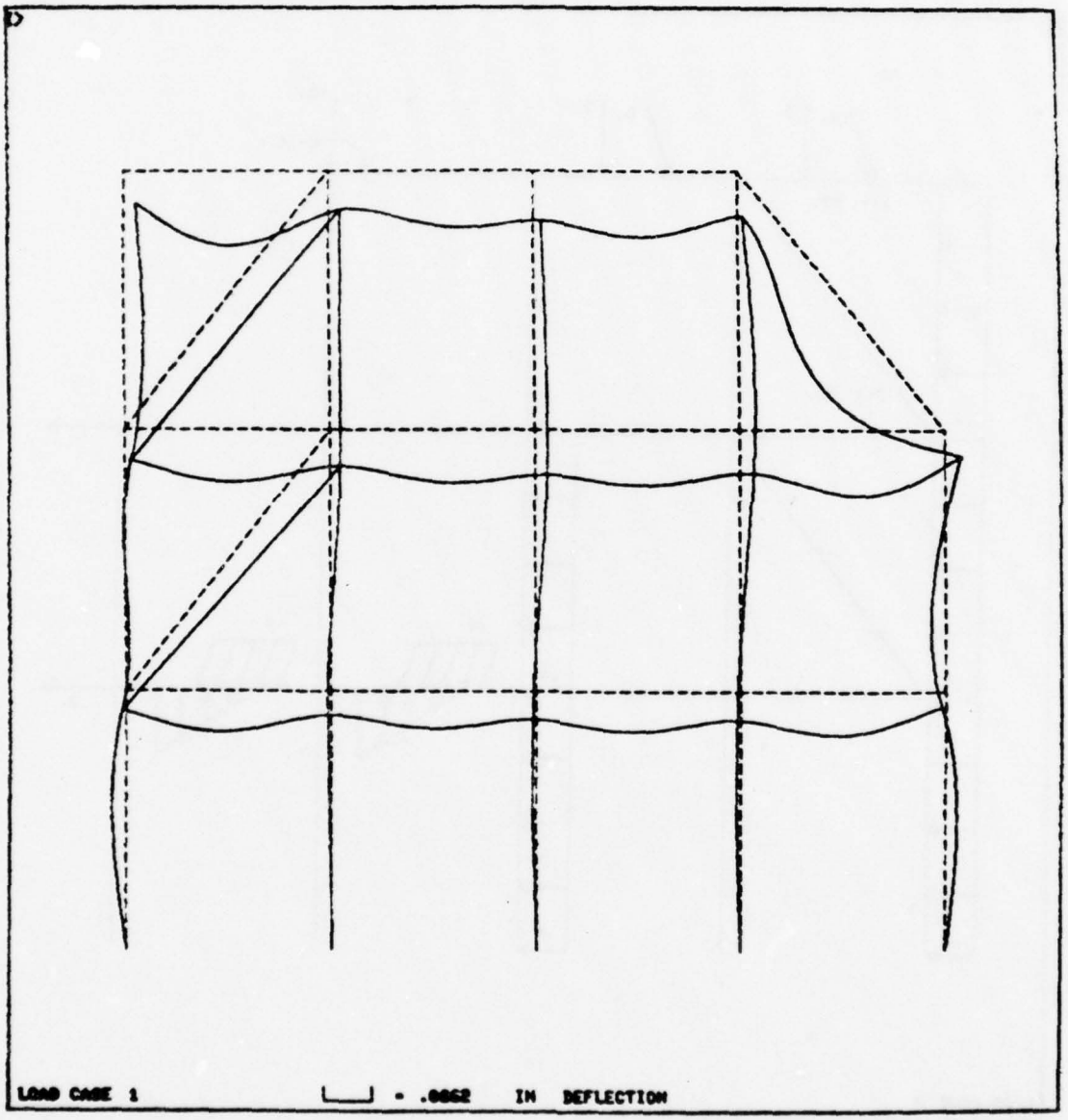


"E" CØMMAND EXECUTES THE ANALYSIS

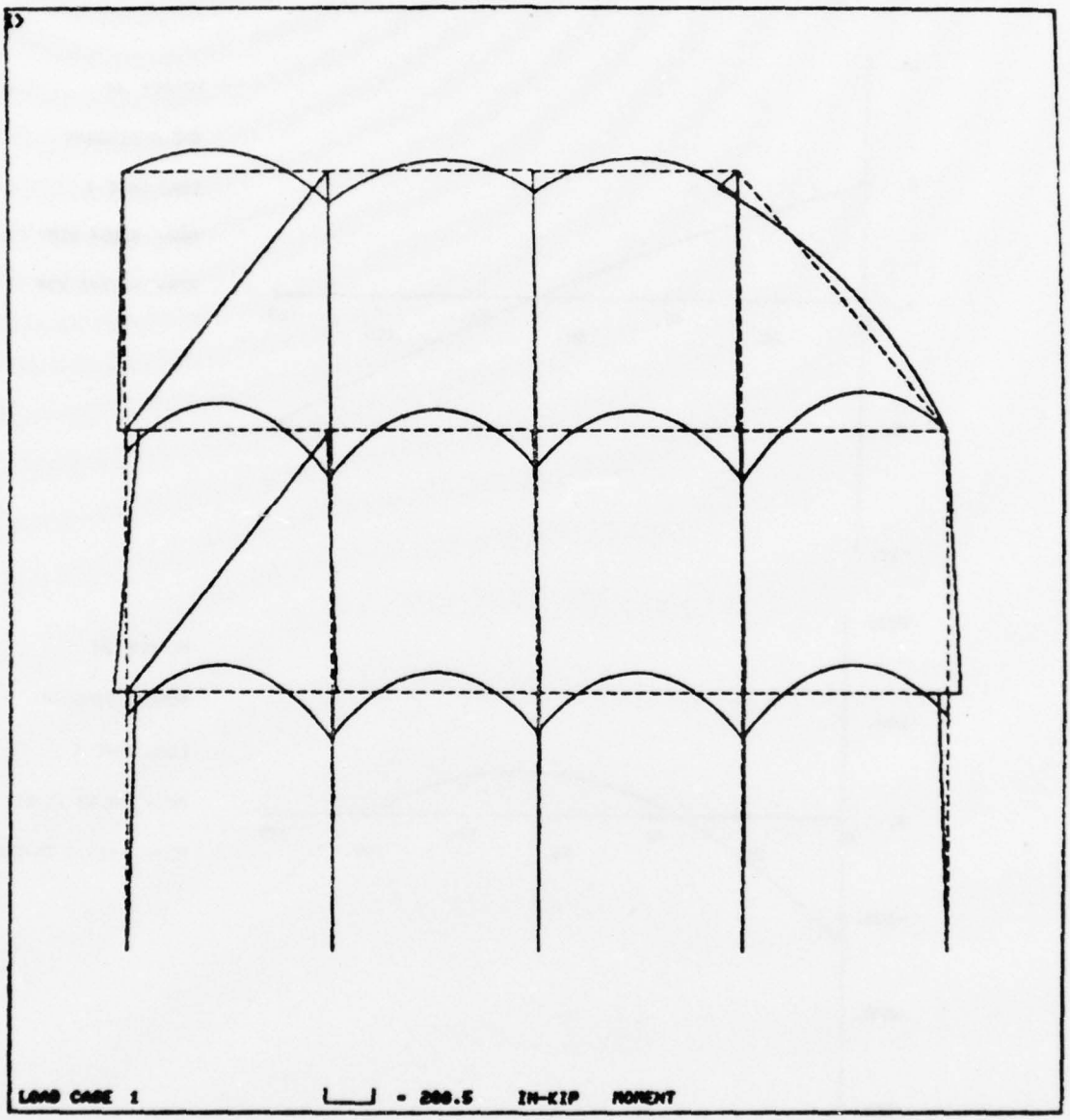
ØUTPUT FILE SAVED= PFILE

ENTER ØUTPUT GRAPHICS CØMMAND

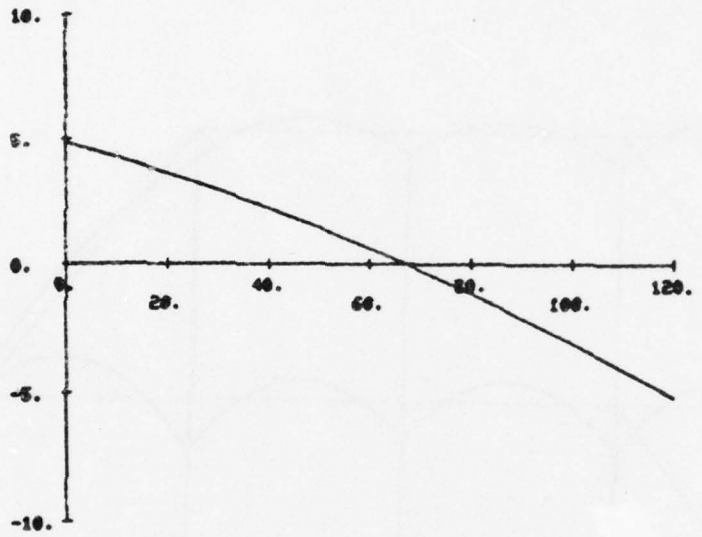
"L 1" PLUS "D" CØMMANDS



"M" CØMMAND



"I 24" CØMMAND



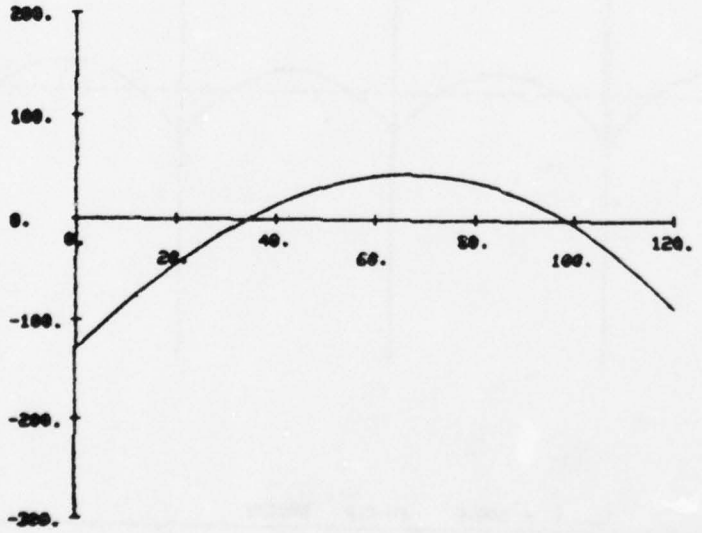
MEMBER 24

SHEAR DIAGRAM

LOAD CASE 1

MAX= 4.854 KIP

MIN= -5.146 KIP



MEMBER 24

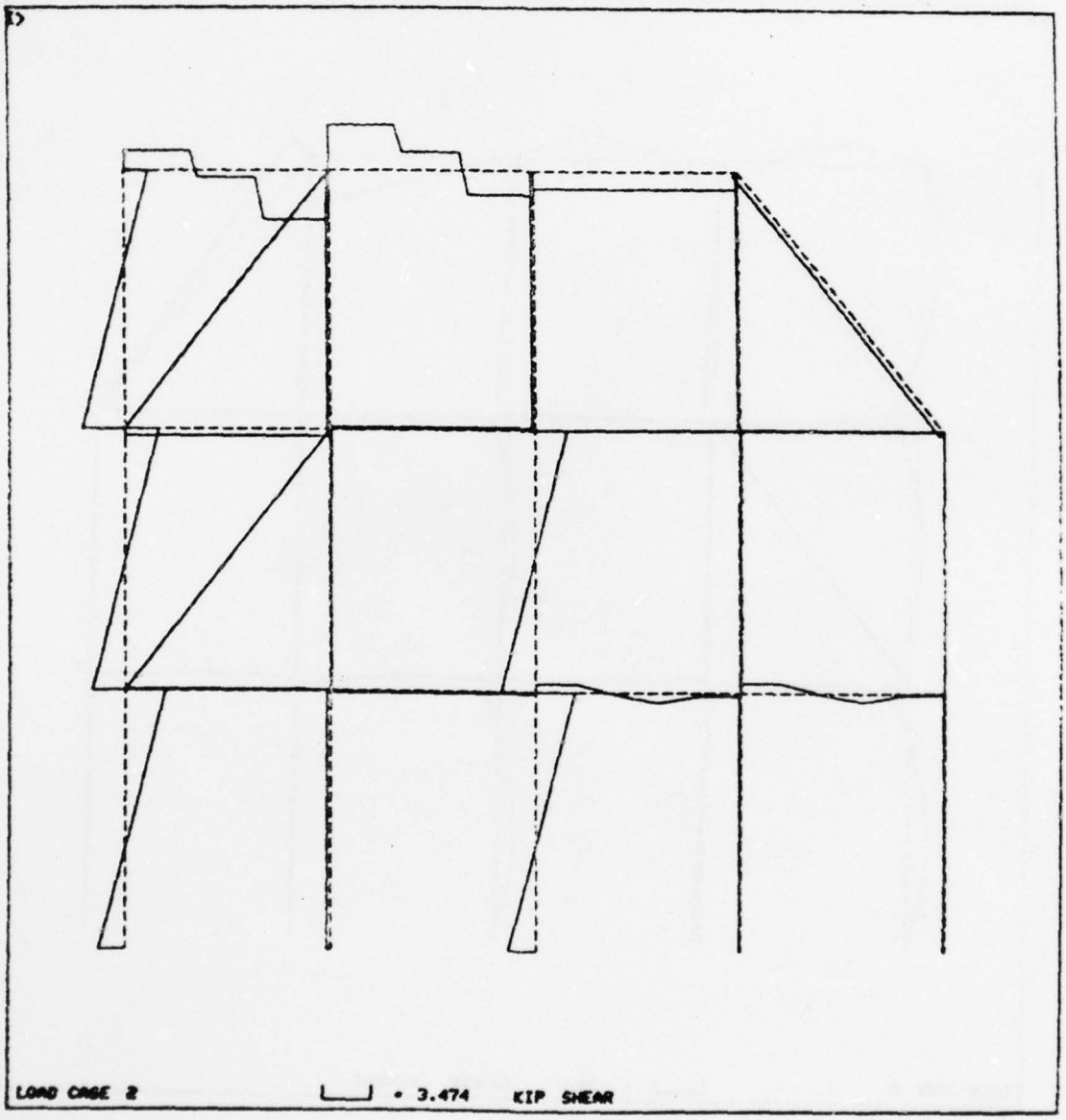
MOMENT DIAGRAM

LOAD CASE 1

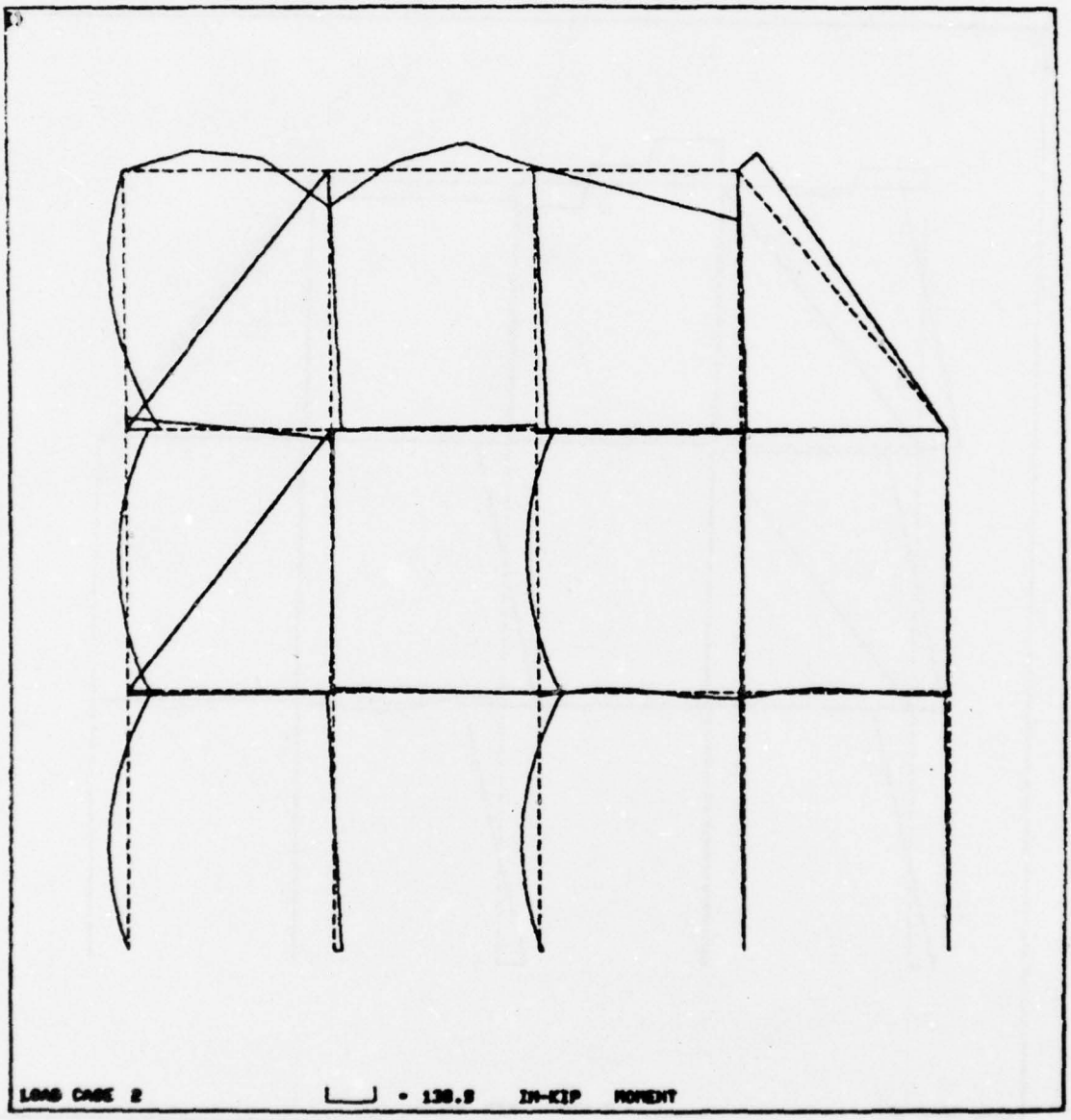
MAX= 44.03 IN-KIP

MIN= -129.4 IN-KIP

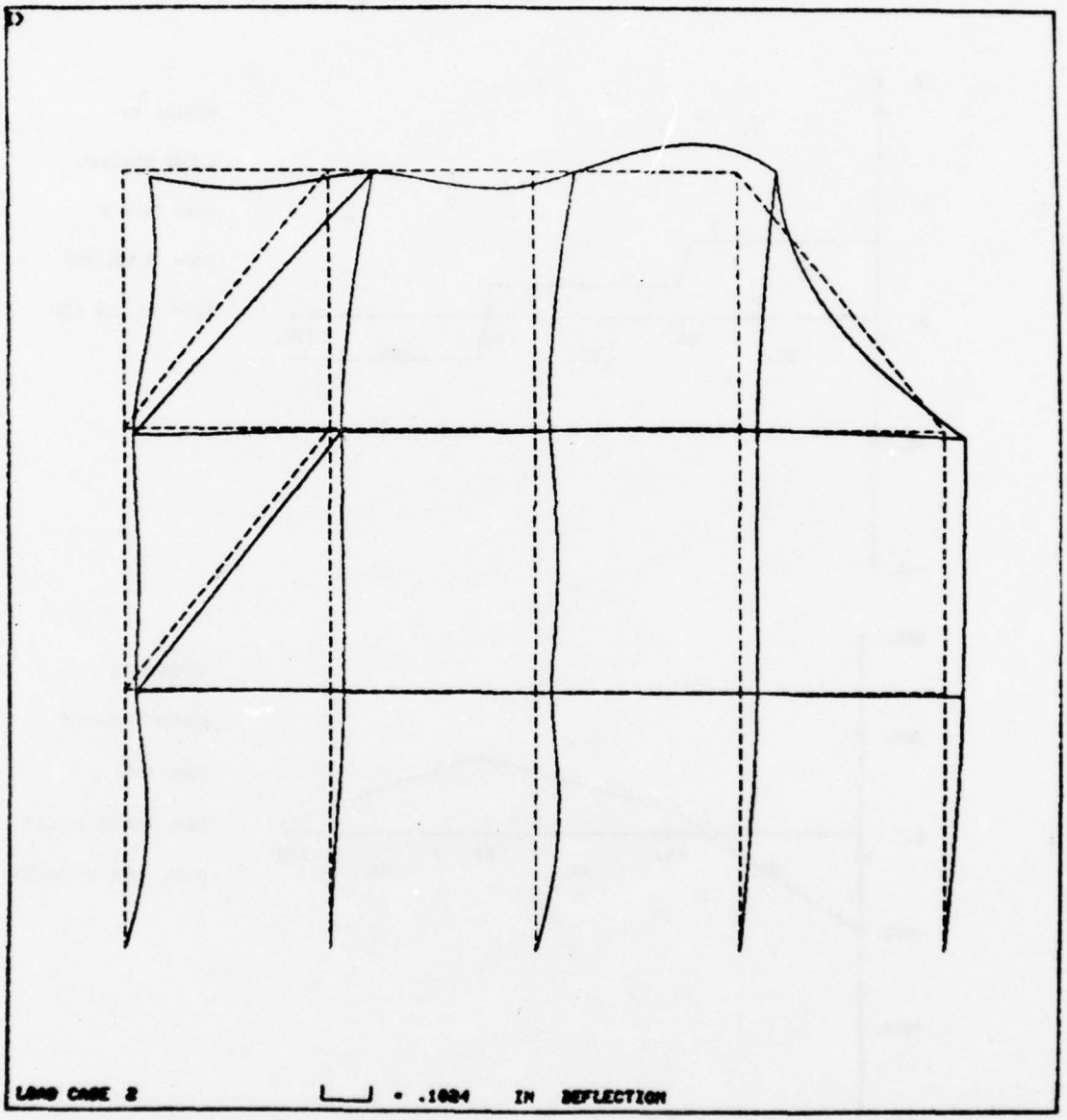
"L 2" PLUS "V" COMMANDS



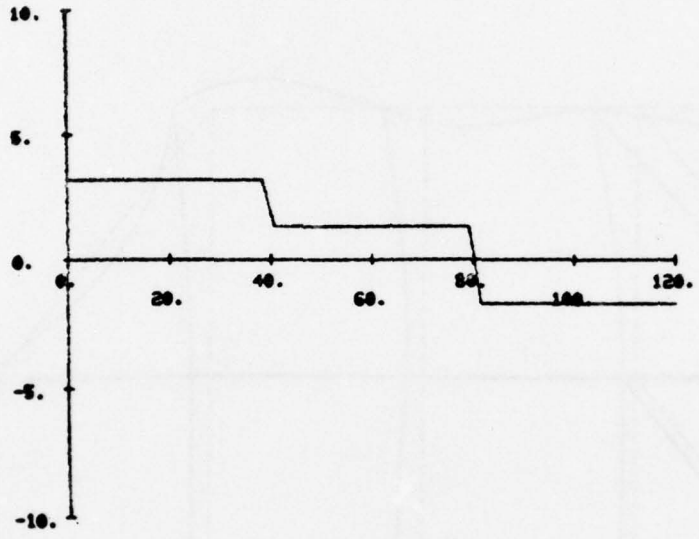
"M" CØMMAND



"D" CØMMAND



"I 24" CØMMAND



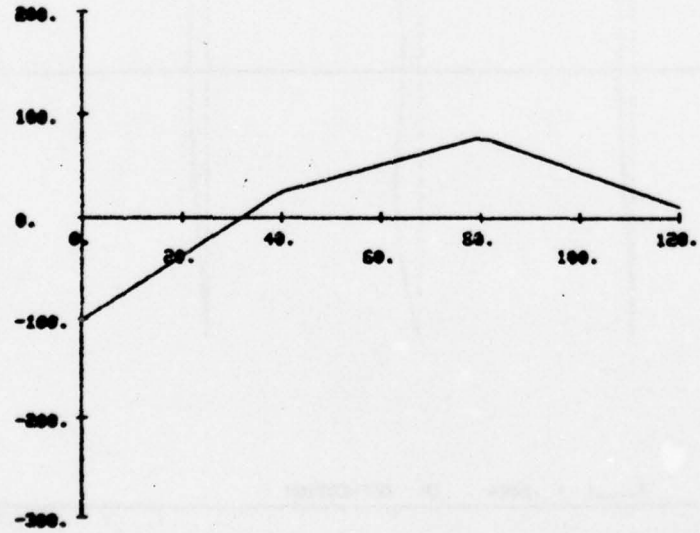
MEMBER 24

SHEAR DIAGRAM

LOAD CASE 2

MAX= 3.181 KIP

MIN= -1.698 KIP



MEMBER 24

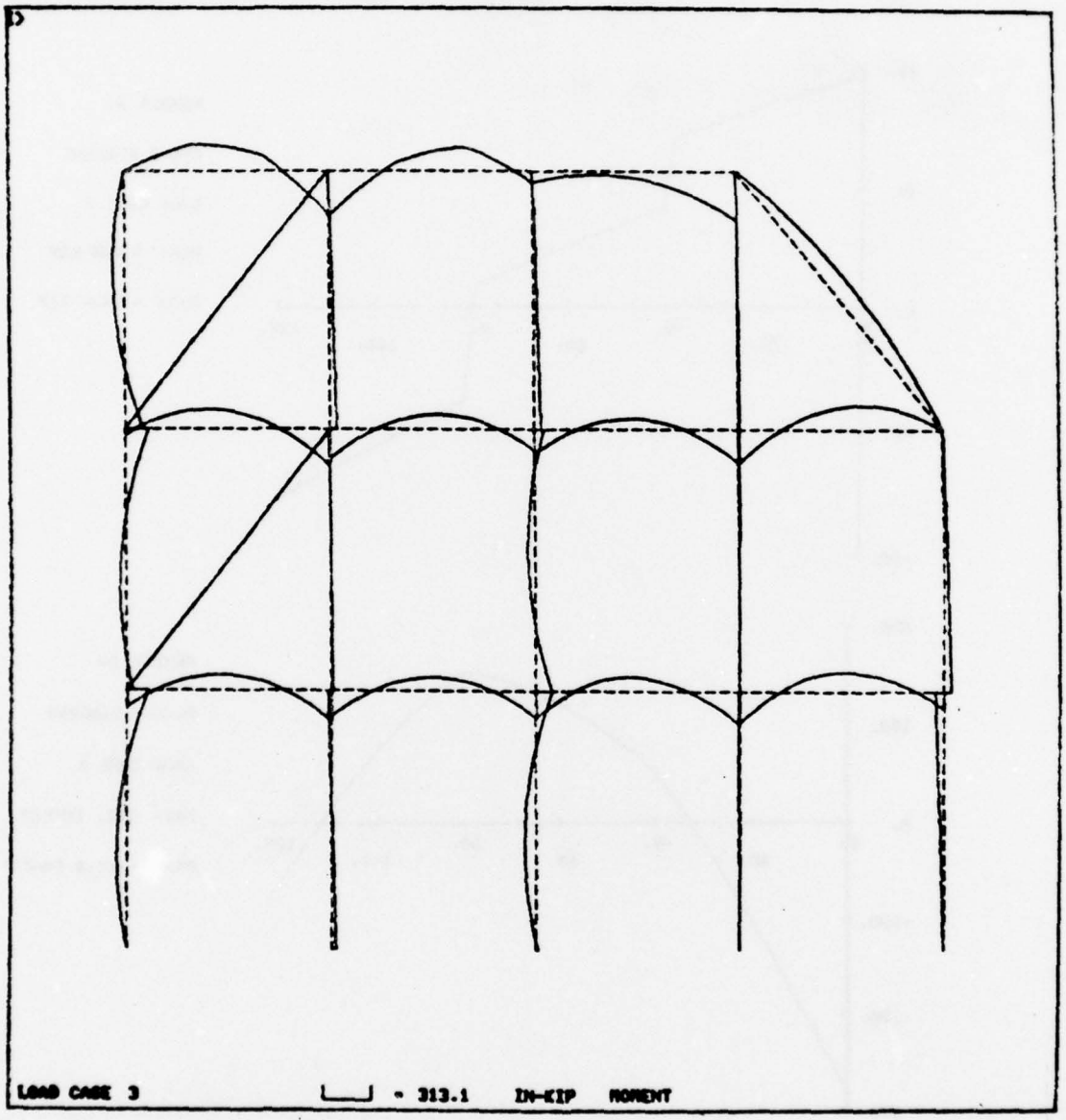
MOMENT DIAGRAM

LOAD CASE 2

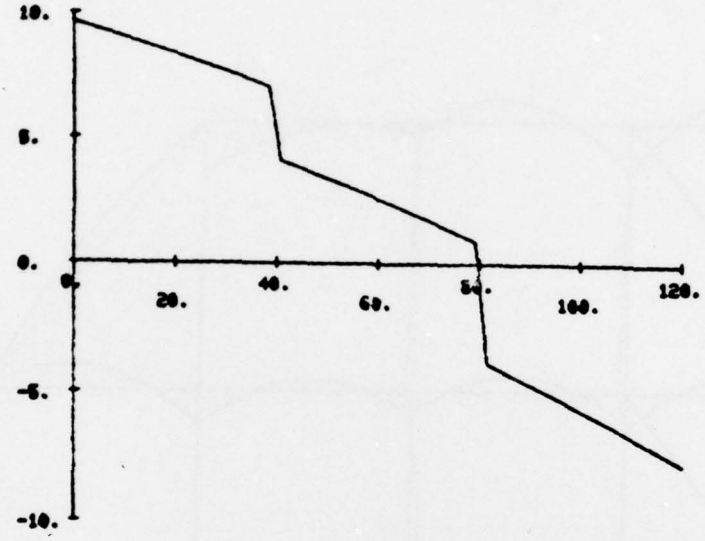
MAX= 76.28 IN-KIP

MIN= -101.2 IN-KIP

"L 3" PLUS "M" COMMANDS



"I 24" CØMMAND



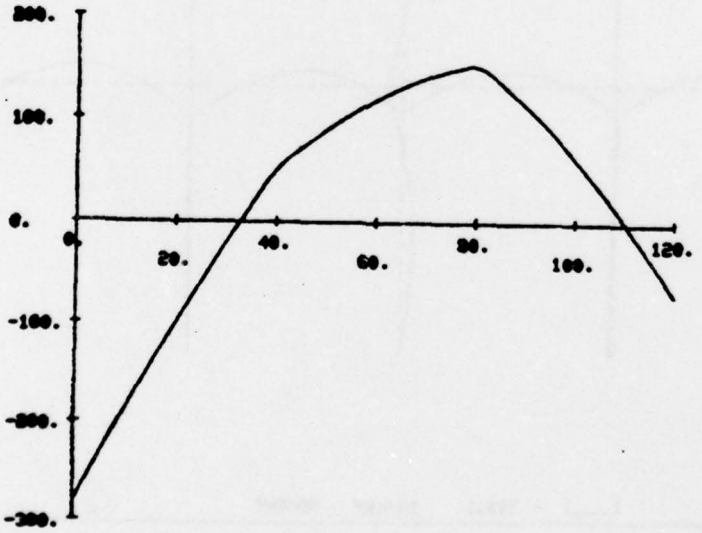
MEMBER 24

SHEAR DIAGRAM

LOAD CASE 3

MAX= 9.625 KIP

MIN= -7.694 KIP



MEMBER 24

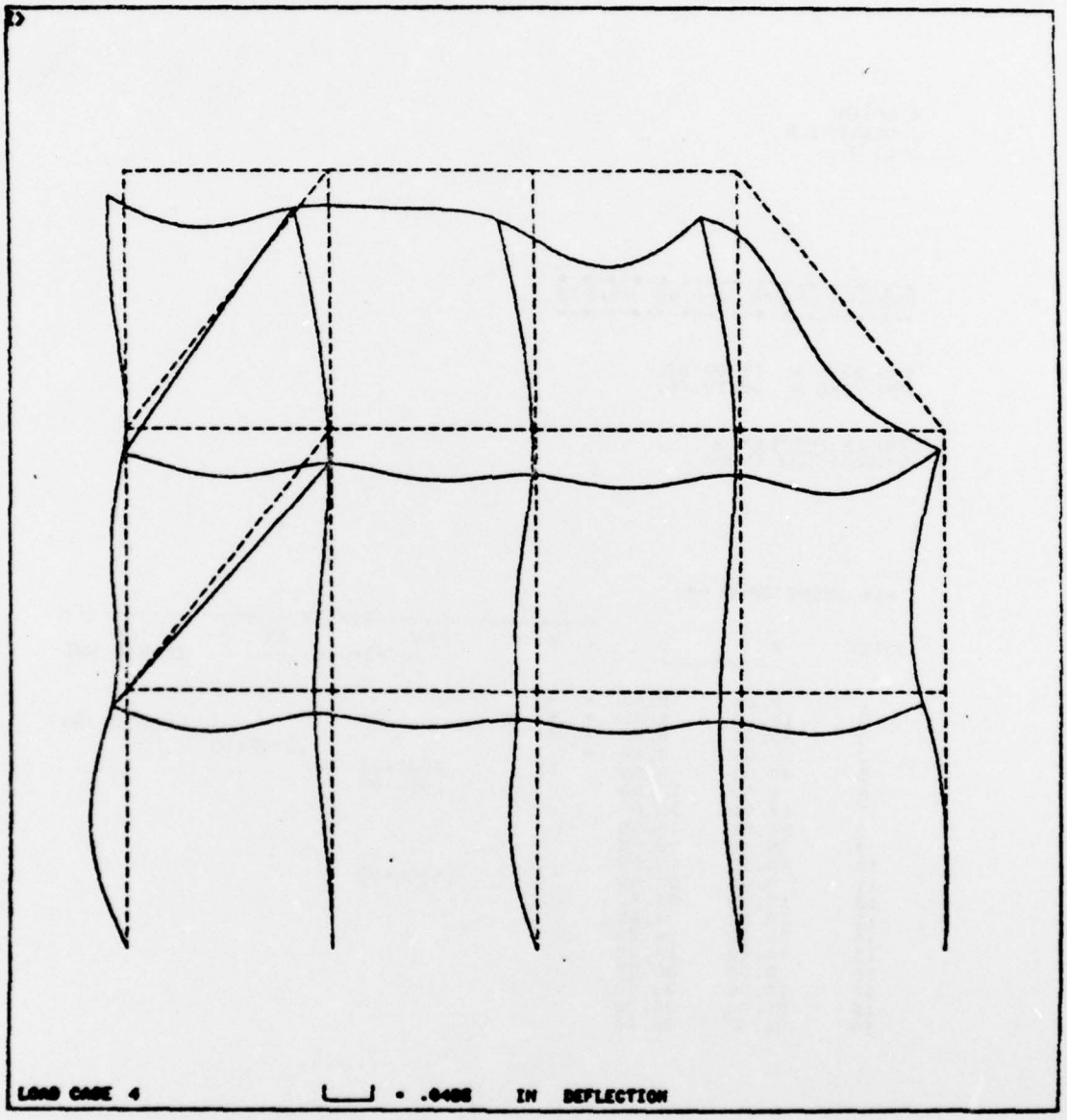
MOMENT DIAGRAM

LOAD CASE 3

MAX= 152. IN-KIP

MIN= -281.2 IN-KIP

"L 4" PLUS "D" CØMMANDS



"S" CØMMAND STØPS THE PRØGRAM

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SAMPLE 3 OUTPUT FILE (PFILE)

```
C>CC,ON
C>OLD,PFILE
C>LIST
```

```
PROGRAM CFRAME V01.00 01SEP78
```

```
RUN DATE =  78/09/01.
RUN TIME =  06.19.46.
```

```
SAMPLE PROBLEM 3
THREE STORY FRAME
```

◆◆◆ JOINT DATA ◆◆◆

JOINT	X	Y	FIXITY X	FIXITY Y	FIXITY R	KX	KY	KR
	----FT----					----KIP/IN----		IN-KIP/RAD
1	0.00	0.00	◆	◆				
2	10.00	0.00	◆	◆	◆			
3	20.00	0.00	◆	◆				.870E+04
4	30.00	0.00	◆				.200E+05	
5	40.00	0.00		◆		.700E+03		
6	0.00	12.00				.700E+03		
7	10.00	12.00						
8	20.00	12.00						
9	30.00	12.00						
10	40.00	12.00						
11	0.00	24.00				.500E+03		
12	10.00	24.00						
13	20.00	24.00						
14	30.00	24.00						
15	40.00	24.00						
16	0.00	36.00						
17	10.00	36.00						
18	20.00	36.00						
19	30.00	36.00						

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*** MEMBER DATA ***

MEMBER	END A	END B	LENGTH FT	I IN**4	A IN**2	AS IN**2	E KSI	G KSI
1	1	6	12.00	96.30	5.61	0.00	.2900E+05	.1115E+05
2	2	7	12.00	96.30	5.61	0.00	.2900E+05	.1115E+05
3	3	8	12.00	96.30	5.61	0.00	.2900E+05	.1115E+05
4	4	9	12.00	96.30	5.61	0.00	.2900E+05	.1115E+05
5	5	10	12.00	96.30	5.61	0.00	.2900E+05	.1115E+05
6	6	11	12.00	96.30	5.61	0.00	.2900E+05	.1115E+05
7	7	12	12.00	96.30	5.61	0.00	.2900E+05	.1115E+05
8	8	13	12.00	96.30	5.61	0.00	.2900E+05	.1115E+05
9	9	14	12.00	96.30	5.61	0.00	.2900E+05	.1115E+05
10	10	-15	12.00	96.30	5.61	0.00	.2900E+05	.1115E+05
11	11	-16	12.00	96.30	5.61	0.00	.2900E+05	.1115E+05
12	12	-17	12.00	96.30	5.61	0.00	.2900E+05	.1115E+05
13	13	-18	12.00	96.30	5.61	0.00	.2900E+05	.1115E+05
14	14	-19	12.00	96.30	5.61	0.00	.2900E+05	.1115E+05
15	6	7	10.00	156.00	6.47	0.00	.2900E+05	.1115E+05
16	7	8	10.00	156.00	6.47	0.00	.2900E+05	.1115E+05
17	8	9	10.00	156.00	6.47	0.00	.2900E+05	.1115E+05
18	9	10	10.00	156.00	6.47	0.00	.2900E+05	.1115E+05
19	11	12	10.00	156.00	6.47	0.00	.2900E+05	.1115E+05
20	12	13	10.00	156.00	6.47	0.00	.2900E+05	.1115E+05
21	13	14	10.00	156.00	6.47	0.00	.2900E+05	.1115E+05
22	14	15	10.00	156.00	6.47	0.00	.2900E+05	.1115E+05
23	16	17	10.00	68.90	4.41	0.00	.3000E+05	.1128E+05
24	17	18	10.00	68.90	4.41	0.00	.3000E+05	.1128E+05
25	18	19	10.00	68.90	4.41	0.00	.3000E+05	.1128E+05
26	19	-15	15.62	68.90	4.41	0.00	.3000E+05	.1128E+05
27	-6	-12	15.62	2.49	9.80	0.00	.2900E+05	.1115E+05
28	-11	-17	15.62	2.49	9.80	0.00	.2900E+05	.1115E+05

*** LOAD CASE 1 DATA ***

MEMBER	LA FT	PA KIP/FT	LB FT	PB KIP/FT	ANGLE DEG
15	0.00	.1600E+01	10.00	.1600E+01	0.00
16	0.00	.1600E+01	10.00	.1600E+01	0.00
17	0.00	.1600E+01	10.00	.1600E+01	0.00
18	0.00	.1600E+01	10.00	.1600E+01	0.00
19	0.00	.1600E+01	10.00	.1600E+01	0.00
20	0.00	.1600E+01	10.00	.1600E+01	0.00
21	0.00	.1600E+01	10.00	.1600E+01	0.00
22	0.00	.1600E+01	10.00	.1600E+01	0.00
23	0.00	.7000E+00	10.00	.1300E+01	0.00
24	0.00	.7000E+00	10.00	.1300E+01	0.00
25	0.00	.7000E+00	10.00	.1300E+01	0.00
26	0.00	.4480E+00	15.62	.4480E+00	50.19

*** LOAD CASE 2 DATA ***

MEMBER	LA FT	PA KIP/FT	LB FT	PB KIP/FT	ANGLE DEG
1	0.00	.4000E+00	12.00	.4000E+00	0.00
3	0.00	.4000E+00	12.00	.4000E+00	0.00
6	0.00	.4000E+00	12.00	.4000E+00	0.00
8	0.00	.4000E+00	12.00	.4000E+00	0.00
11	0.00	.4000E+00	12.00	.4000E+00	0.00
17	2.00	.4000E+00	6.00	.4000E+00	20.00
17	3.00	0.	8.00	-.3000E+00	0.00
18	2.00	.4000E+00	6.00	.4000E+00	20.00
18	3.00	0.	8.00	-.3000E+00	0.00

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MEMBER	L FT	P KIP	ANGLE DEG
23	3.30	.2000E+01	-20.00
23	6.70	.3000E+01	0.00
24	3.30	.2000E+01	-20.00
24	6.70	.3000E+01	0.00

JOINT	FORCE X KIP	FORCE Y KIP	MOMENT FT-KIP
10	.3000E+01	0.	0.
15	.3000E+01	0.	0.
19	0.	-.5000E+01	-.1800E+02

MEMBER	ALPHA	DT
23	.6500E-05	.5000E+02
28	.6500E-05	.5000E+02

◆◆◆ LOAD CASE COMBINATIONS ◆◆◆

LOAD CASE	LOAD CASE FACTORS 1	2
3	1.00	1.50
4	.75	-.50

LOAD CASE 1

JOINT DISPLACEMENTS

JOINT	DX IN	DY IN	DR RAD
1	0.	0.	.3384E-03
2	0.	0.	0.
3	0.	0.	.6855E-04
4	0.	-.1947E-02	.8550E-04
5	.3849E-03	0.	-.2973E-03
6	-.5720E-02	-.2512E-01	-.5577E-03
7	-.5283E-02	-.3084E-01	.3301E-04
8	-.5013E-02	-.3583E-01	-.4803E-04
9	-.4875E-02	-.3641E-01	-.6944E-04
10	-.4817E-02	-.1978E-01	.7030E-03
11	.8179E-02	-.3946E-01	-.5770E-03
12	.1346E-01	-.4669E-01	-.1193E-04
13	.1622E-01	-.5779E-01	-.4049E-04
14	.1910E-01	-.5594E-01	-.1588E-03
15	.2210E-01	-.3308E-01	.1426E-02
16	.1561E-01	-.4249E-01	-.1671E-02
17	.1542E-01	-.5181E-01	.3797E-03
18	.1095E-01	-.6620E-01	-.9263E-04
19	.6456E-02	-.5944E-01	.1484E-03

STRUCTURE REACTIONS

JOINT	FORCE X KIP	FORCE Y KIP	MOMENT IN-KIP
1	.2414E+00	.2839E+02	0.
2	.3262E-01	.3485E+02	-.2989E+01
3	.3968E-01	.4048E+02	-.5963E+00
4	.4173E-01	.3894E+02	0.
5	-.2694E+00	.2235E+02	0.
6	.4004E+01	0.	0.
11	-.4090E+01	0.	0.
TOTAL	.5339E-03	.1650E+03	

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LOAD CASE 2

JOINT	JOINT DISPLACEMENTS DX IN	DY IN	DR RAD
1	0.	0.	-.1043E-02
2	0.	0.	0.
3	0.	0.	-.9927E-03
4	0.	.1948E-04	-.3451E-03
5	.1082E-03	0.	-.3601E-03
6	.2281E-01	-.5037E-02	.1261E-03
7	.2840E-01	-.2101E-02	-.4893E-04
8	.3424E-01	-.8917E-03	0.
9	.3647E-01	.3643E-03	-.6949E-04
10	.3847E-01	-.6713E-02	-.7901E-04
11	.1886E-01	-.1210E-01	-.1066E-03
12	.2512E-01	-.4347E-02	0.
13	.3247E-01	-.1176E-02	.1238E-03
14	.3820E-01	.1460E-02	-.8878E-04
15	.4380E-01	-.1335E-01	-.1407E-03
16	.5702E-01	-.1335E-01	-.7727E-03
17	.9486E-01	-.4006E-02	.4671E-04
18	.8917E-01	-.1577E-02	.1174E-02
19	.8388E-01	.2599E-02	-.2550E-02

JOINT	STRUCTURE REACTIONS FORCE X KIP	FORCE Y KIP	MOMENT IN-KIP
1	-.1915E+01	.5690E+01	0.
2	-.2793E+00	.2373E+01	.2106E+02
3	-.1990E+01	.1007E+01	.8636E+01
4	-.7424E-01	-.3896E+00	0.
5	-.7571E-01	.7584E+01	0.
6	-.1596E+02	0.	0.
11	-.9428E+01	0.	0.
TOTAL	-.2973E+02	.1627E+02	

LOAD CASE 3

JOINT	JOINT DISPLACEMENTS DX IN	DY IN	DR RAD
1	0.	0.	-.1226E-02
2	0.	0.	0.
3	0.	0.	-.1420E-02
4	0.	-.1918E-02	-.4322E-03
5	.5471E-03	0.	-.8374E-03
6	.2849E-01	-.3268E-01	-.3685E-03
7	.3732E-01	-.3399E-01	-.4038E-04
8	.4634E-01	-.3717E-01	-.3344E-04
9	.4983E-01	-.3586E-01	-.1737E-03
10	.5288E-01	-.2985E-01	.5844E-03
11	.3646E-01	-.5761E-01	-.7369E-03
12	.5114E-01	-.5322E-01	-.2676E-04
13	.6492E-01	-.5956E-01	.1451E-03
14	.7640E-01	-.5375E-01	-.2920E-03
15	.8780E-01	-.5310E-01	.1215E-02
16	.1011E+00	-.6251E-01	-.2830E-02
17	.1577E+00	-.5782E-01	.4498E-03
18	.1447E+00	-.6856E-01	.1668E-02
19	.1323E+00	-.5554E-01	-.3677E-02

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JOINT	STRUCTURE REACTIONS FORCE X KIP	FORCE Y KIP	MOMENT IN-KIP
1	-.2631E+01	.3692E+02	0.
2	-.3863E+00	.3841E+02	.2859E+02
3	-.2945E+01	.4199E+02	.1236E+02
4	-.6963E-01	.3835E+02	0.
5	-.3830E+00	.3372E+02	0.
6	-.1994E+02	0.	0.
11	-.1823E+02	0.	0.
TOTAL	-.4459E+02	.1894E+03	

LOAD CASE 4

JOINT	JOINT DISPLACEMENTS DX IN	DY IN	DR RAD
1	0.	0.	.7754E-03
2	0.	0.	0.
3	0.	0.	.5477E-03
4	0.	-.1470E-02	.2367E-03
5	.2346E-03	0.	-.4294E-04
6	-.1569E-01	-.1633E-01	-.4813E-03
7	-.1816E-01	-.2208E-01	.4922E-04
8	-.2088E-01	-.2643E-01	-.4088E-04
9	-.2189E-01	-.2749E-01	-.1734E-04
10	-.2285E-01	-.1148E-01	.5667E-03
11	-.3293E-02	-.2354E-01	-.3794E-03
12	-.2469E-02	-.3285E-01	0.
13	-.4072E-02	-.4276E-01	-.9225E-04
14	-.4773E-02	-.4268E-01	-.7472E-04
15	-.5322E-02	-.1813E-01	.1140E-02
16	-.1680E-01	-.2519E-01	-.8666E-03
17	-.3587E-01	-.3685E-01	.2614E-03
18	-.3637E-01	-.4886E-01	-.6563E-03
19	-.3710E-01	-.4588E-01	.1386E-02

JOINT	STRUCTURE REACTIONS FORCE X KIP	FORCE Y KIP	MOMENT IN-KIP
1	.1139E+01	.1844E+02	0.
2	.1641E+00	.2495E+02	-.1277E+02
3	.1025E+01	.2996E+02	-.4765E+01
4	.6842E-01	.2940E+02	0.
5	-.1642E+00	.1297E+02	0.
6	.1099E+02	0.	0.
11	.1647E+01	0.	0.
TOTAL	.1486E+02	.1156E+03	

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MEMBER END FORCES

MEMBER	LOAD CASE	JOINT	AXIAL KIP	SHEAR KIP	MOMENT IN-KIP	MOMENT EXTREMA IN-KIP	LOCATION IN
1	1	1	-.2839E+02	-.2414E+00	0.	0.	0.00
		6	-.2839E+02	.2414E+00	-.3476E+02	-.3476E+02	144.00
	2	1	-.5690E+01	.1915E+01	0.	.5500E+02	57.60
		6	-.5690E+01	.2885E+01	-.6985E+02	-.6985E+02	144.00
	3	1	-.3692E+02	.2631E+01	0.	.6921E+02	51.84
		6	-.3692E+02	.4569E+01	-.1395E+03	-.1395E+03	144.00
	4	1	-.1844E+02	-.1139E+01	0.	.8855E+01	144.00
		6	-.1844E+02	-.1261E+01	.8855E+01	-.3888E+02	69.12
2	1	2	-.3485E+02	-.3262E-01	.2989E+01	.2989E+01	0.00
		7	-.3485E+02	.3262E-01	-.1709E+01	-.1709E+01	144.00
	2	2	-.2373E+01	.2793E+00	-.2106E+02	.1916E+02	144.00
		7	-.2373E+01	-.2793E+00	.1916E+02	-.2106E+02	0.00
	3	2	-.3841E+02	.3863E+00	-.2859E+02	.2703E+02	144.00
		7	-.3841E+02	-.3863E+00	.2703E+02	-.2859E+02	0.00
	4	2	-.2495E+02	-.1641E+00	.1277E+02	.1277E+02	0.00
		7	-.2495E+02	.1641E+00	-.1086E+02	-.1086E+02	144.00
3	1	3	-.4048E+02	-.3968E-01	.5963E+00	.5963E+00	0.00
		8	-.4048E+02	.3968E-01	-.5118E+01	-.5118E+01	144.00
	2	3	-.1007E+01	.1990E+01	-.8636E+01	.5075E+02	60.48
		8	-.1007E+01	.2810E+01	-.6768E+02	-.6768E+02	144.00
	3	3	-.4199E+02	.2945E+01	-.1236E+02	.7434E+02	57.60
		8	-.4199E+02	.4255E+01	-.1066E+03	-.1066E+03	144.00
	4	3	-.2986E+02	-.1025E+01	.4765E+01	.3000E+02	144.00
		8	-.2986E+02	-.1375E+01	.3000E+02	-.2673E+02	60.48
4	1	4	-.3894E+02	-.4173E-01	0.	0.	0.00
		9	-.3894E+02	.4173E-01	-.6010E+01	-.6010E+01	144.00
	2	4	.3896E+00	.7424E-01	0.	.1069E+02	144.00
		9	.3896E+00	-.7424E-01	.1069E+02	0.	0.00
	3	4	-.3835E+02	.6963E-01	0.	.1003E+02	144.00
		9	-.3835E+02	-.6963E-01	.1003E+02	0.	0.00
	4	4	-.2940E+02	-.6842E-01	0.	0.	0.00
		9	-.2940E+02	.6842E-01	-.9853E+01	-.9853E+01	144.00
5	1	5	-.2235E+02	.2694E+00	0.	.3880E+02	144.00
		10	-.2235E+02	-.2694E+00	.3880E+02	0.	0.00
	2	5	-.7584E+01	.7571E-01	0.	.1090E+02	144.00
		10	-.7584E+01	-.7571E-01	.1090E+02	0.	0.00
	3	5	-.3372E+02	.3830E+00	0.	.5515E+02	144.00
		10	-.3372E+02	-.3830E+00	.5515E+02	0.	0.00
	4	5	-.1297E+02	.1642E+00	0.	.2365E+02	144.00
		10	-.1297E+02	-.1642E+00	.2365E+02	0.	0.00
6	1	6	-.1619E+02	-.7609E+00	.5441E+02	.5441E+02	0.00
		11	-.1619E+02	.7609E+00	-.5516E+02	-.5516E+02	144.00
	2	6	-.7983E+01	.2371E+01	-.6005E+02	.2429E+02	72.00
		11	-.7983E+01	.2429E+01	-.6417E+02	-.6417E+02	144.00
	3	6	-.2817E+02	.2796E+01	-.3567E+02	.4248E+02	54.72
		11	-.2817E+02	.4404E+01	-.1514E+03	-.1514E+03	144.00
	4	6	-.8154E+01	-.1756E+01	.7084E+02	.7084E+02	0.00
		11	-.8154E+01	-.6436E+00	-.9284E+01	-.2170E+02	106.56
7	1	7	-.1791E+02	.2274E+00	-.1724E+02	.1550E+02	144.00
		12	-.1791E+02	-.2274E+00	.1550E+02	-.1724E+02	0.00
	2	7	-.2538E+01	-.8434E-01	.6830E+01	.6830E+01	0.00
		12	-.2538E+01	.8434E-01	-.5315E+01	-.5315E+01	144.00
	3	7	-.2172E+02	.1009E+00	-.6998E+01	.7526E+01	144.00
		12	-.2172E+02	-.1009E+00	.7526E+01	-.6998E+01	0.00
	4	7	-.1216E+02	.2127E+00	-.1635E+02	.1428E+02	144.00
		12	-.1216E+02	-.2127E+00	.1428E+02	-.1635E+02	0.00

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8	1	8	-.2481E+02	.1667E+00	-.1186E+02	.1215E+02	144.00
		13	-.2481E+02	-.1667E+00	.1215E+02	-.1186E+02	0.00
	2	8	-.3209E+00	.2488E+01	-.6173E+02	.3113E+02	74.88
		13	-.3209E+00	.2312E+01	-.4905E+02	-.6173E+02	0.00
	3	8	-.2529E+02	.3899E+01	-.1044E+03	.4755E+02	77.76
		13	-.2529E+02	.3301E+01	-.6143E+02	-.1044E+03	0.00
	4	8	-.1845E+02	-.1119E+01	.2197E+02	.3364E+02	144.00
		13	-.1845E+02	-.1281E+01	.3364E+02	-.1559E+02	66.24
9	1	9	-.2206E+02	.8463E-01	-.7826E+01	.4360E+01	144.00
		14	-.2206E+02	-.8463E-01	.4360E+01	-.7826E+01	0.00
	2	9	.1238E+01	-.1085E+00	.7438E+01	.7438E+01	0.00
		14	.1238E+01	.1085E+00	-.8186E+01	-.8186E+01	144.00
	3	9	-.2020E+02	-.7812E-01	.3330E+01	.3330E+01	0.00
		14	-.2020E+02	.7812E-01	-.7919E+01	-.7919E+01	144.00
	4	9	-.1716E+02	.1177E+00	-.9588E+01	.7363E+01	144.00
		14	-.1716E+02	-.1177E+00	.7363E+01	-.9588E+01	0.00
10	1	10	-.1502E+02	.3596E+00	-.5178E+02	0.	144.00
		15	-.1502E+02	-.3596E+00	0.	-.5178E+02	0.00
	2	10	-.7500E+01	-.1697E-01	.2443E+01	.2443E+01	0.00
		15	-.7500E+01	.1697E-01	0.	0.	144.00
	3	10	-.2627E+02	.3341E+00	-.4811E+02	0.	144.00
		15	-.2627E+02	-.3341E+00	0.	-.4811E+02	0.00
	4	10	-.7515E+01	.2781E+00	-.4005E+02	0.	144.00
		15	-.7515E+01	-.2781E+00	0.	-.4005E+02	0.00
11	1	11	-.3422E+01	-.2123E+00	.3057E+02	.3057E+02	0.00
		16	-.3422E+01	.2123E+00	0.	0.	144.00
	2	11	-.1406E+01	.3064E+01	-.9562E+02	.4520E+02	92.16
		16	-.1406E+01	.1736E+01	0.	-.9562E+02	0.00
	3	11	-.5530E+01	.4384E+01	-.1129E+03	.7927E+02	86.40
		16	-.5530E+01	.2816E+01	0.	-.1129E+03	0.00
	4	11	-.1864E+01	-.1691E+01	.7073E+02	.7073E+02	0.00
		16	-.1864E+01	-.7088E+00	0.	-.1507E+02	100.80
12	1	12	-.5777E+01	.6739E-03	-.9704E-01	0.	144.00
		17	-.5777E+01	-.6739E-03	0.	-.9704E-01	0.00
	2	12	.3854E+00	.1917E+00	-.2760E+02	0.	144.00
		17	.3854E+00	-.1917E+00	0.	-.2760E+02	0.00
	3	12	-.5199E+01	.2882E+00	-.4150E+02	0.	144.00
		17	-.5199E+01	-.2882E+00	0.	-.4150E+02	0.00
	4	12	-.4526E+01	-.9533E-01	.1373E+02	.1373E+02	0.00
		17	-.4526E+01	.9533E-01	0.	0.	144.00
13	1	13	-.9497E+01	-.3113E-01	.4483E+01	.4483E+01	0.00
		18	-.9497E+01	.3113E-01	0.	0.	144.00
	2	13	-.4528E+00	.2091E+00	-.3011E+02	0.	144.00
		18	-.4528E+00	-.2091E+00	0.	-.3011E+02	0.00
	3	13	-.1018E+02	.2825E+00	-.4068E+02	0.	144.00
		18	-.1018E+02	-.2825E+00	0.	-.4068E+02	0.00
	4	13	-.6896E+01	-.1279E+00	.1842E+02	.1842E+02	0.00
		18	-.6896E+01	.1279E+00	0.	0.	144.00
14	1	14	-.3956E+01	-.9964E-01	.1435E+02	.1435E+02	0.00
		19	-.3956E+01	.9964E-01	0.	0.	144.00
	2	14	.1287E+01	.9231E-01	-.1329E+02	0.	144.00
		19	.1287E+01	-.9231E-01	0.	-.1329E+02	0.00
	3	14	-.2025E+01	.3882E-01	-.5590E+01	0.	144.00
		19	-.2025E+01	-.3882E-01	0.	-.5590E+01	0.00
	4	14	-.3611E+01	-.1209E+00	.1741E+02	.1741E+02	0.00
		19	-.3611E+01	.1209E+00	0.	0.	144.00
15	1	6	.6829E+00	.7191E+01	-.8917E+02	.1046E+03	52.80
		7	.6829E+00	.8809E+01	-.1863E+03	-.1863E+03	120.00
	2	6	.8754E+01	.5325E-01	-.9794E+01	-.3404E+01	120.00
		7	.8754E+01	-.5325E-01	-.3404E+01	-.9794E+01	0.00
	3	6	.1381E+02	.7271E+01	-.1039E+03	.9434E+02	55.20
		7	.1381E+02	.8729E+01	-.1914E+03	-.1914E+03	120.00
	4	6	-.3865E+01	.5366E+01	-.6198E+02	.8197E+02	52.80
		7	-.3865E+01	.6634E+01	-.1380E+03	-.1380E+03	120.00

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16	1	7	.4229E+00	.8128E+01	-.1708E+03	.7694E+02	60.00
		8	.4229E+00	.7872E+01	-.1554E+03	-.1708E+03	0.00
	2	7	.9117E+01	-.1119E+00	.8924E+01	.8924E+01	0.00
		8	.9117E+01	.1119E+00	-.4502E+01	-.4502E+01	120.00
	3	7	.1410E+02	.7961E+01	-.1574E+03	.8026E+02	60.00
		8	.1410E+02	.8039E+01	-.1621E+03	-.1621E+03	120.00
	4	7	-.4241E+01	.6152E+01	-.1325E+03	.5668E+02	62.40
		8	-.4241E+01	.5848E+01	-.1143E+03	-.1325E+03	0.00
17	1	8	.2165E+00	.7797E+01	-.1486E+03	.7930E+02	57.60
		9	.2165E+00	.8203E+01	-.1730E+03	-.1730E+03	120.00
	2	8	.3819E+01	.5746E+00	-.1046E+02	.8616E+01	43.20
		9	.3272E+01	.1789E+00	-.1676E+02	-.1676E+02	120.00
	3	8	.5945E+01	.8659E+01	-.1643E+03	.8839E+02	55.20
		9	.5124E+01	.8472E+01	-.1981E+03	-.1981E+03	120.00
	4	8	-.1747E+01	.5560E+01	-.1062E+03	.5705E+02	60.00
		9	-.1474E+01	.6063E+01	-.1214E+03	-.1214E+03	120.00
18	1	9	.9013E-01	.8672E+01	-.1712E+03	.1108E+03	64.80
		10	.9013E-01	.7328E+01	-.9057E+02	-.1712E+03	0.00
	2	9	.3455E+01	.6692E+00	-.1350E+02	.9763E+01	45.60
		10	.2907E+01	.8435E-01	-.8458E+01	-.1350E+02	0.00
	3	9	.5272E+01	.9676E+01	-.1914E+03	.1201E+03	60.00
		10	.4451E+01	.7455E+01	-.1033E+03	-.1914E+03	0.00
	4	9	-.1660E+01	.6169E+01	-.1216E+03	.8070E+02	67.20
		10	-.1386E+01	.5454E+01	-.6370E+02	-.1216E+03	0.00
19	1	11	.8253E+01	.7117E+01	-.8573E+02	.1042E+03	52.80
		12	.8253E+01	.8883E+01	-.1917E+03	-.1917E+03	120.00
	2	11	.9802E+01	-.4633E+00	.3144E+02	.3144E+02	0.00
		12	.9802E+01	.4633E+00	-.2415E+02	-.2415E+02	120.00
	3	11	.2296E+02	.6422E+01	-.3857E+02	.1161E+03	48.00
		12	.2296E+02	.9578E+01	-.2279E+03	-.2279E+03	120.00
	4	11	.1289E+01	.5570E+01	-.8002E+02	.7507E+02	55.20
		12	.1289E+01	.6430E+01	-.1317E+03	-.1317E+03	120.00
20	1	12	.4312E+01	.8250E+01	-.1761E+03	.7914E+02	62.40
		13	.4312E+01	.7750E+01	-.1461E+03	-.1761E+03	0.00
	2	12	.1148E+02	.1150E+00	-.1863E+01	.1194E+02	120.00
		13	.1148E+02	-.1150E+00	.1194E+02	-.1863E+01	0.00
	3	12	.2153E+02	.8422E+01	-.1789E+03	.8711E+02	62.40
		13	.2153E+02	.7578E+01	-.1282E+03	-.1789E+03	0.00
	4	12	-.2506E+01	.6130E+01	-.1311E+03	.5670E+02	62.40
		13	-.2506E+01	.5870E+01	-.1155E+03	-.1311E+03	0.00
21	1	13	.4510E+01	.7566E+01	-.1384E+03	.7620E+02	57.60
		14	.4510E+01	.8434E+01	-.1905E+03	-.1905E+03	120.00
	2	13	.8959E+01	-.1687E-01	-.7001E+01	-.7001E+01	0.00
		14	.8959E+01	.1687E-01	-.9025E+01	-.9025E+01	120.00
	3	13	.1795E+02	.7541E+01	-.1489E+03	.6424E+02	57.60
		14	.1795E+02	.8459E+01	-.2040E+03	-.2040E+03	120.00
	4	13	-.1097E+01	.5683E+01	-.1003E+03	.6113E+02	57.60
		14	-.1097E+01	.6317E+01	-.1384E+03	-.1384E+03	120.00
22	1	14	.4695E+01	.9671E+01	-.2005E+03	.1502E+03	72.00
		15	.4695E+01	.6329E+01	0.	-.2005E+03	0.00
	2	14	.8759E+01	.3265E-01	-.3918E+01	0.	120.00
		15	.8759E+01	-.3265E-01	0.	-.3918E+01	0.00
	3	14	.1783E+02	.9720E+01	-.2064E+03	.1479E+03	72.00
		15	.1783E+02	.6280E+01	0.	-.2064E+03	0.00
	4	14	-.8584E+00	.7237E+01	-.1484E+03	.1134E+03	72.00
		15	-.8584E+00	.4763E+01	0.	-.1484E+03	0.00
23	1	16	-.2123E+00	.3422E+01	0.	.8949E+02	50.40
		17	-.2123E+00	.6578E+01	-.1294E+03	-.1294E+03	120.00
	2	16	.4126E+02	.1406E+01	0.	.5509E+02	40.80
		17	.4195E+02	.3474E+01	-.1012E+03	-.1012E+03	120.00
	3	16	.6168E+02	.5530E+01	0.	.1690E+03	40.80
		17	.6271E+02	.1179E+02	-.2812E+03	-.2812E+03	120.00
	4	16	-.2079E+02	.1864E+01	0.	.4216E+02	52.80
		17	-.2113E+02	.3197E+01	-.4641E+02	-.4641E+02	120.00

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24	1	17	-.4924E+01	.4854E+01	-.1294E+03	.4403E+02	67.20
		18	-.4924E+01	.5146E+01	-.8691E+02	-.1294E+03	0.00
	2	17	-.6727E+01	.3181E+01	-.1012E+03	.7628E+02	79.20
		18	-.6043E+01	.1698E+01	.1059E+02	-.1012E+03	0.00
	3	17	-.1501E+02	.9625E+01	-.2812E+03	.1520E+03	79.20
		18	-.1399E+02	.7694E+01	-.7102E+02	-.2812E+03	0.00
	4	17	-.3293E+00	.2050E+01	-.4641E+02	.6048E+01	57.60
		18	-.6713E+00	.3010E+01	-.7048E+02	-.7048E+02	120.00
25	1	18	-.4955E+01	.4351E+01	-.8691E+02	.5415E+02	62.40
		19	-.4955E+01	.5649E+01	-.1048E+03	-.1048E+03	120.00
	2	18	-.5834E+01	-.1246E+01	.1059E+02	.1059E+02	0.00
		19	-.5834E+01	.1246E+01	-.1389E+03	-.1389E+03	120.00
	3	18	-.1371E+02	.2483E+01	-.7102E+02	-.2263E+02	38.40
		19	-.1371E+02	.7517E+01	-.3131E+03	-.3131E+03	120.00
	4	18	-.7992E+00	.3886E+01	-.7048E+02	.7648E+02	72.00
		19	-.7992E+00	.3614E+01	-.9155E+01	-.7048E+02	0.00
26	1	19	-.4536E+01	.2799E+01	-.1048E+03	.5911E+02	116.22
		15	-.9912E+01	.1681E+01	0.	-.1048E+03	0.00
	2	19	-.9462E+01	-.4115E+00	.7713E+02	.7713E+02	0.00
		15	-.9462E+01	.4115E+00	0.	0.	187.45
	3	19	-.1873E+02	.2182E+01	.1090E+02	.1105E+03	89.97
		15	-.2411E+02	.2298E+01	0.	0.	187.45
	4	19	.1329E+01	.2305E+01	-.1172E+03	.3104E+02	127.46
		15	-.2703E+01	.1055E+01	0.	-.1172E+03	0.00
27	1	6	-.6510E+01	0.	0.	0.	0.00
		12	-.6510E+01	0.	0.	0.	0.00
	2	6	.3053E+01	0.	0.	0.	0.00
		12	.3053E+01	0.	0.	0.	0.00
	3	6	-.1930E+01	0.	0.	0.	0.00
		12	-.1930E+01	0.	0.	0.	0.00
	4	6	-.6409E+01	0.	0.	0.	0.00
		12	-.6409E+01	0.	0.	0.	0.00
28	1	11	-.7361E+01	0.	0.	0.	0.00
		17	-.7361E+01	0.	0.	0.	0.00
	2	11	.8320E+02	0.	0.	0.	0.00
		17	.8320E+02	0.	0.	0.	0.00
	3	11	.1174E+03	0.	0.	0.	0.00
		17	.1174E+03	0.	0.	0.	0.00
	4	11	-.4712E+02	0.	0.	0.	0.00
		17	-.4712E+02	0.	0.	0.	0.00

APPENDIX B
SUMMARY OF BASIC INPUT DATA

1. Text

2. UE UJ UM UD UF

3. NJ NM NLC E POI

4. JN X Y, JN X Y, . . .

5. "FIX X" list, "FIX Y" list, "FIX R" list

6. MN JNA JNB, MN JNA JNB, . . .

7. "PIN A" list, "PIN B" list

8. I A AS list

9. "LOAD CASE" NDLS NCLS NJLS

10. LA PA LB PB Φ list

11. NL, L1 P1 Φ1, L2 P2 Φ2, . . . , list

12. PX PY M list

Commentary:

1. Any text description of the problem.

2. Units for modulus of elasticity, joint coordinates, member properties, displacements, and forces.

3. The number of joints, members, and load cases, and modulus of elasticity and Poisson's ratio. The shear modulus G = E/2(1+POI).

4. The joint number and the X and Y coordinates. Any number of joints may be placed on a single line.

5. Specifies zero X, Y, or R displacement for the listed joints.

6. The member number and the end A and end B joints of the member. Any number of members may be placed on the single line.

7. Specifies a pin (no moment transfer) at end A or end B of the listed members.

8. The moment of inertia, axial area, and shear areas for the listed members. If AS = 0., shear deformations are not included. Use as many of these data lines as required.

9. The number of sets of member distributed loads, member concentrated loads, and joint loads for the load case.

10. The distance from end A of the listed members to the start of the distributed load, the magnitude at the start, the distance from end A to the end of the load, the magnitude at the end, and the angle the load makes with normal to the member. Use NDLS of these lines.

11. The number of concentrated loads on each listed member, the distance from end A of the member to each load, the magnitude of each load, and the angle each load makes with normal to the member. Use NCLS of these lines.

12. Specifies the X and Y forces and the moment applied to the listed joints. Use NJLS of these lines. Return to Line 9 for each new load case.

NOTE: Each line must begin with a line number and a blank. Items in quotation marks must be input exactly as shown, without the quotation marks. Numbers must be input as integers or real numbers. Refer to the main portion of the user's manual for sign conventions, further commentary, or further capabilities.

APPENDIX C
SUMMARY OF COMPLETE INPUT DATA

1. Text*

1a. Text

2. UE UJ UM UD UF

3. NJ NM NLC E POI

4. JN X Y, JN X Y, . . .

5. "GJ" JNA JNB INCR

6. "FIX X" list, "FIX Y" list, "FIX R" list

7. "FIX KX" KX list, "FIX KY" KY List, "FIX KR" KR list

8. "SD" DX DY DR list

9. MN JNA JNB, MN JNA JNB, . . .

10. "GM" MN JNA JNB N INCM INCJ

11. "PIN A" list, "PIN B" list

12. I A AS list -or- 0. B H list

13. "E" E POI list

14. "LOAD CASE" NDLS NCLS NJLS NTLS

15. LA PA LB PB Φ list

16. NL, L1 P1 Φ1, L2 P2 Φ2, . . . , list

17. PX PY M list

18. ALPHA DT list

19. LCN1 C1, LCN2 C2, . . .

NOTE: Each line must begin with a line number and a blank. Items in quotation marks must be input exactly as shown, without the quotation marks. Numbers must be input as integers or real numbers, as appropriate. Refer to the main portion of the user's manual for sign conventions, units, and commentary on the input.

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

Hartman, Joseph P
User's guide: computer program with interactive graphics for analysis of plane frame structures (CFRAME) / by Joseph P. Hartman, John J. Jobst, U. S. Army Engineer District, St. Louis, St. Louis, Mo. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1979.
iii, 17, [35] p., ill. ; 27 cm. (Instruction report - U. S. Army Engineer Waterways Experiment Station ; O-79-2)
Prepared for Office, Chief of Engineers, U. S. Army, Washington, D. C.

1. CFRAME (Computer program). 2. Computer programs. 3. Framed structures. 4. Interactive computer graphics. 5. Structural analysis. I. Jobst, John J., joint author. II. United States. Army. Corps of Engineers. III. United States. Army. Corps of Engineers. St. Louis District. IV. Title. V. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Instruction report ; O-79-2.
TA7·W34i no.O-79-2